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Direct Alternating Currents. AN English contemporary in discussing the subject of the production of direct currents from alternating currents (see Digest) refers, in an incredulous manner, it is true, to the fact that if two alternating currents in quadrature varying as the square on the sine of time are redressed and superimposed, a theoretically direct and steady current will result. This follows, of course, from the sum of the square of the sine and cosine being unity, the two wave curves being supposed identical in their dimensions. As by a proper proportioning of the armature and poles of an alternating machine currents following the law stated can be produced, it would be interesting to have the experiment tried. While currents following this law would cause an increase of impedance, this increase would not be greater or as great as in the many ordinary machines whose currents depart from the sine law. The motor-dynamo is perhaps the best means that will be found to transform alternating into continuous currents, but the method of direct transformation nevertheless has not yet had its possibilities exhausted.

Electrical Notation, Symbols and Abbreviations. As it may be some time before the official text of the system of electrical notation, symbols and abbreviations reported by the Committee on Notation of the Chamber of Delegates of the International Electrical Congress is printed, M. Hospitalier, at our request, has kindly furnished The Electrical World with a copy of the full text as definitively accepted, which we print elsewhere along with the resolutions of the Committee and Chamber bearing on the subject. While the Chamber of Delegates does not in express terms adopt the system, for the reason that such action was not within its province, the sanction implied by making it part of the official report of the Chamber will have the practical effect desired. The system has the great merit of being not only logical throughout and based upon correct principles, but at the same time possesses the essentially practical and international character necessary, which is far from being the case with some other systems proposed. M. Hospitalier is to be congratulated upon this final recognition of his labors in the cause of international scientific notation.

Experimental Alternating Apparatus. THE alternating current may now be said to have the lead over its continuous current rival, and it appears that the latter will cut but little figure hereafter except for comparatively minor or special applications. Owing to the complexity of the theory of the alternating current, which involves for its expression the higher branches of mathematics, the investigator or inventor with but little acquirements in this direction will be placed at a decided disadvantage in the absence of experimental means. It is, however, doubtful if even the most expert mathematician in this branch would have a very decided advantage as far as relates to the design or improvement of apparatus. A slight modification, the effect of which could be easily traced with an experimental apparatus, might so involve the mathematical expression as to entirely bury the important consequences. In addition, to render alternating currents at all amenable to mathematical analysis, it is necessary to assume that they follow some simple law, such as the sine law, while in practice it is only by accident, it may be said, that this law will hold true. While the investigations of Kennelly and others have shown that if the alternating current is constrained to follow the sine law certain advantages result, yet this may not hold for all cases, and at any rate the full consequences of any variation from it are exceedingly difficult to trace mathematically. Other reasons might be adduced to show that the experimental method of analysis of alternating current phenomena is the only practical method and one that will have to be adopted by inventors. One advantage of this necessity is the likelihood of the discovery of principles that, as remarked before, would be obscured by the mathematical treatment, and as a consequence the field for research is one that promises a good return to the investigator. In this connection the first installment of a series of articles by Lieut. Patten is of unusual value, and with those that will follow should notably increase the ranks of experimental workers in this field. As will be seen, the outlay is small for an apparatus from which simple and three-phase alternating currents may be obtained, and it will be shown later that but little extra complication is required to procure two-phase currents, increase the rate of alternations and transform to continuous currents of desired voltages. It may be remarked that a simple apparatus like this is better for obtaining original results than the elaborate ones to which the experimenter is liable to become a mere attendant. Whoever inspects the simple and crude apparatus in the Royal Institution at London by means of which Faraday, Davy, Young and others accomplished wonders, and reflects upon the magnificent equipment of college laboratories which nevertheless add little or nothing to original research, will ever thereafter have a respect for an experimental equipment however simple and even crude.

The Metric System. OUR thoughtful contemporary, *Engineering News*, has been advocating the general adoption of the metric system, and while we think the difficulties are enormous in the way of displacing entirely our present cumbersome and irrational systems of weights and measures, we quite agree that for shopwork this may be done with no more inconvenience than warranted by the immediate benefit. Electrical engineering should be a peculiarly promising field in which to start the innovation, and it is much to be regretted that the exclusive use of the metric system in electrical theory did not have the effect it should in electrical workshop practice. A great deal of the prejudice against the metric system is undoubtedly due to the tables inserted in schoolbooks. If the system really involved the use of these it is not surprising that it should be considered difficult and impracticable, and one of the first measures should be the attempt to correct the misrepresentation and consequent harm produced by the makers of schoolbooks and others who misrepresent the system by the absurd tables they give as its practical expression. The only rational objection against the metric system in workshops of which we know is that it does not admit of division by halves and is thus at variance with a natural mental process which can be applied to the usual system. In other days when the rule of thumb prevailed in workshops and when the designer decided upon dimensions by squinting at a rule until he moved a finger to what he considered the right point, this objection might have had some weight. Nowadays, however, when dimensions are determined otherwise than by intuition and when shop superintendents and workmen are required to blindly follow figured drawings, it is a matter of indifference what the unit is. When a sixty-fourth of an inch was the theoretical limit in workmanship, and the thirty-second the practical one, there may have been some slight weight to an objection in regard to the dimension of the millimetre; but now when the hundredth of an inch more often prevails as the practical limit, and when some shops claim that their extreme limit is the three-thousandth of an inch, this argument is turned the other way. The claim that the displacement of the point in decimal measurements is an objection is not worthy of consideration in face of the employment of indices for feet and inches and the mistakes they frequently lead to. We are aware that some electrical workshops employ the metric system, but it is almost deplorable that it is not thus used generally, not only on account of its convenience and uniformity with the purely electrical system, but because of the ease in adoption by a new industry, and, above all, from the effect there would thus be in accelerating its adoption generally. This is peculiarly a subject for the National Electric Light and Street Railway associations, and we sincerely trust that it will before long receive attention at their hands.

Its Baptism of Fire. IN order to obtain the opinions of those competent to judge as to the effect of the recent financial depression on electrical industries and the prospects for the immediate future, THE ELECTRICAL WORLD last week addressed inquiries to representative firms engaged in the electrical business and kindred interests, and in other columns of this issue we print the responses received. The views expressed are not only gratifying as indicating the satisfactory manner in which the storm has been weathered, but also from the hopeful tone as to the future. After the successful outcome of the war of the Rebellion, European statesmen had a much more wholesome regard for the stability of American institutions than had prevailed before the republic had been tested by fire. From this time on, investors and others will feel even more strongly than they have that electrical securities are based on a business that is sound and solid, and one that in the hour of panic and confusion kept right on its triumphal march, while others, older and apparently better able to bear the strain, fell by the wayside. That sanguine anticipations as to the future, and the immediate future, are warranted follows from the nature of many of the applications of electricity. The operation of the lighting, street railway and power plants already in existence require supplies, and these will be purchased independently of any financial derangement. The great returns from electric railways, one of the most important of the electrical industries, will always be a powerful incentive toward investing money in this direction, and the instability of the general stock market will cause investors to canvass the local field and put their money, withdrawn from other investments, into one that a little examination will show has in almost every case proved profitable. Cutting down expenses will also bring to the front the advantages of isolated electric lighting plants. Calculations showing the great saving in this item in mills and large buildings will now be more closely and more favorably studied without their effect being minimized by the bugbear of first cost, for attention to economical operation is always stimulated by diminishing profits. In fact, almost every branch of electrical industries has a bright outlook except those of a speculative character, and it will probably prove of advantage in the long run to have a curb placed on this class of electrical enterprise. Great speculative schemes for a time may have a buoyant effect on the market, but they are likely to detract attention from less brilliant but more legitimate measures, and in case of failure they depress industries with which they have little or even no direct connection. That so many men in different sections of the country and in different departments of electrical application should, independently and each for himself, reach the same conclusion—that the electrical business has so safely and so satisfactorily passed through its "baptism of fire," and that its future is so bright—ought to be a source of the greatest comfort to all of us, not only to the men who, by their energy and pluck and indomitable perseverance, achieve the results, but also to the journalists who, in their own modest way, try to do their part by chronicling and recording these results and the processes which led up to them.

How the Electrical Industries Withstood the Financial Stress.

In emerging, much more happily than the first indications of trouble made it likely, from the throes of the commercial depression that deranged all affairs of business, the electrical industry has proved that it is founded upon a sound and permanent basis. In no other branch of the nation's commerce has there been so little evidence of weakness. There have been no such tremendous failures as have convulsed other trades. The strain has been intense; but the ease with which it was met demonstrated, as nothing else could, on what broad and sound principles the business houses and corporations engaged in the application and development of electricity administer their affairs.

That the electrical business is in a healthy condition is a self-apparent fact. It withstood the shock of the crisis of 1893—happily now a thing that can be spoken of in the past tense—in a way to demonstrate its ability to take full advantage of the more prosperous era now dawning on the country.

There is no need to recapitulate here the causes instrumental in dispelling the reign of distrust and fear and bringing about a return of confidence. The powerful agents that have restored to the business men of the country their belief in the solvency of themselves and their fellow workers are still in operation, and with daily increasing force. The result must be a renewal of trade activity, the extent of which will be measured by an inverse comparison with the gloom and apathy of two months ago. In this revival the electric trade must fully share. The commercial depression did not discover any signs of inherent weakness to prevent its taking full advantage of the renewed prosperity.

The appended interviews which The Electrical World has had during the past few days with representatives of the various departments of electrical application are uniform in the cheery view taken of the outlook. The opinion is practically unanimous that the future contains only what is reassuring; that business in all directions must pick up; that there is every reason to believe that even an unusual degree of activity will prevail—in fact, that a good season is right at hand, and at least, so far as the electrical business is concerned, that the year to come promises to fully make up for whatever has been missed this year. The views are those of men in a position to know whereof they speak, and the whole trade must find much in the interviews that will interest and be comforting. Two of the replies received, owing to their length and interest, are printed as separate articles and immediately follow the others.

FROM THE EASTERN STATES.

W. J. Clark, of the General Electric Company: "Everything that comes within range of our notice has a hint or two of encouragement in it. The change that has come along the whole line is the source of greatest comfort to those engaged in the electrical business. In contrasting the present state of affairs with the dullness that prevailed during the summer months, the improvement that has made itself manifest since the first of the month relieves the minds of managing officials of a heavy burden. The way orders for, and inquiries regarding, electrical apparatus are now coming in proves all fears of continued lack of business to have been utterly groundless. The orders, too, are from the people who have money to pay for the goods they desire; this makes the situation even more favorable. Why, we have just received from one of our largest out-of-town offices, a report showing that within the last four weeks sales have been the heaviest since the office was established. The monetary troubles that have so seriously affected all business are mending. Our collections are infinitely better; this is especially true of the more recent sales, and for this reason: The chief effect of the panic has been to put the trade upon a cash basis all around, and hereafter cash payments will be demanded in more instances. The railway trade is, of course through with for this year; the sale for next season's goods will not begin till about December. We are relying chiefly upon our electric lighting and power business."

H Ward Leonard, president of the H. Ward Leonard Co. and of the Carpenter Enamel Rheostat Co.: "The Carpenter Enamel Company is now doing the largest business in its history. The factory is running night and day, and we are speedily making up for business lost during the depression. The improvement during the past two weeks has been most marked. Of course, like all the others, the Carpenter company and the Leonard company felt the prevailing dullness, but contracts are now coming in at a most satisfactory rate. Last week alone we closed eleven contracts for electric lighting. This is good business. The worst is over. People who are in a condition to take care of their legitimate liabilities will do a good fall business. Such businesses as are founded on wind must sooner or later fall by the wayside."

J E. Ham, general agent of W. R. Brixey, Day's Kerite: "Business is holding its own with us. Our factory is running full time, and I think the future looks bright enough to keep the machinery in motion. Confidence seems to be returning to the trade, and there is a slight improvement in collections. As we had a number of large contracts from the first of the year, we have not felt the financial depression very seriously. In fact, the aggregate amount of our sales to Sept. 1 has been double what it was in '92. The outlook is bright for a good fall trade."

H. B. Coho, general sales agent of The Waddell-Entz Co.: "We are receiving an increasing lot of orders, and they are coming from sources that we like to trade with. Our principal trouble has been with collections, but these are getting much easier. People are now promising to pay at a definite time, while before it was simply wait and get your money when you could. The demand for our goods at present is principally from the East, but Western reports are encouraging. We did a very large business last fall, and possibly the trade may not be as great this year, though I feel confident that business will resume its normal conditions by December."

H. L. Lutkin. Manager of the Crocker-Wheeler Co.: "Business is a little better, and I have noticed a marked improvement within the last few days. More orders are coming in every day, especially for dynamos. Our factory has been running all summer, though on limited time during August. Next week we shall run on full time, and will probably have to increase our force. Of course, we have found it difficult at times to make collections, but the trade has been as accommodating as possible to us. I think the outlook for the fall and winter trade is very bright."

Western Electric Company: "There is a general improvement in all branches of trade, and we take a very cheerful view of the outlook. In a month or so everything will come around with the old-time alacrity."

Captain W. L. Candee, of the Okonite Company: "We have nothing to complain of. Our factory has been running continuously all summer, and we are now receiving so many orders that we have to refuse some, as we are not able to fill all of them. Money is now much easier. During this financial depression the only trouble we had was our inability to pay our workingmen in cash. But this was a trouble that other concerns had to deal with, and reflected nothing more than the scarcity of actual currency and not of funds themselves. The rush of business has actually prevented my taking any vacation, and its continuance threatens to keep me tied down for the rest of the year."

Chas. D. Shain, New York, agent of the Siemens & Halske Company, the Weston Electrical Instrument Company and the Carpenter Enamel Rheostat Company: "The Siemens & Halske company has done a business this summer away in excess of its expectations. We have closed several important contracts, and are now figuring on some of the largest contracts ever offered to the electrical trade. The supply business has been dull, but is now picking up, and collections are being made with some degree of promptness. I find trade conditions better in New York than elsewhere, but there is a move for the better all over the country."

Henry R. Worthington, through a representative: "Our business is flourishing, especially with the electrical people, who are now among our best customers. Our dealings with them have been mostly with large companies, who are engaged in fitting big central stations. As their work is not influenced particularly by the money market, we find trade has not slackened to a great extent during the hard times. We have several large contracts for equipping electrical stations with our condensers, and orders and inquiries are coming in daily. Money is now easier and with the consequent better collections we think business for this year will tally with that of last."

J. W. Godfrey, general manager of the New York Insulated Wire Company: "Collections are coming in considerably better, and that is a great confidence restorative. We had quite a number of accounts that, when the financial depression came, we were very much worried over, but as the bills are now being paid, this gives us great encouragement. We have had to be very conservative, however, in the matter of taking orders, and are yet. There are many buildings being erected in this city, and while work upon them, owing to the hard times, shows some abatement, their ultimate completion will make a great demand for electrical apparatus. I have just returned from a trip West, and find business affairs in New York in much better shape than in Western cities. I think we will have as good a trade this year as last. When people get over their scare better times will come."

The Abendroth & Root Manufacturing Company: "Our business with electrical and street railway companies is rather limited at present, as, indeed, it is with other trades. We usually do a good boiler business with electrical people, but apparently manufacturers are now repairing their boilers instead of ordering new ones. However, we have some large contracts with big electrical companies, and trust that more will follow."

Dr. F. A. M. Burrell, of Charles A. Schieren & Co.: "We are doing a fair business with electrical concerns, chiefly because the electrical business is not affected so much by trade depression as are other lines. People must have light, and belts are required to help produce the light. We have not found it particularly difficult to make collections from electrical companies, though many of them are new and are run on a limited capital."

M. M. Hayden, representing the Law Battery Company: "Business has begun to pick up in the last two weeks, and we are now receiving many inquiries as to prices and cost of shipment. This is the best indication of a turn for the better that I know of. We deal mostly with jobbers, and for the last two months they have purchased very conservatively. They must now buy in order to replenish their stock of goods. Most of our orders at the present time are coming in from the West but the people in this section are also beginning to buy. Collections are easier than they have been; and this, of course, lightens business burdens. I think we will do as good a fall business this year as we ever have."

The John A. Roebling Sons' Company: "Business is somewhat better than it was a month ago, but still it is not entirely satisfactory. We find even yet that collections are hard to make, and electrical people do not seem to be freer with their money than those in any other branch of business. While the present outlook is not as encouraging as we should like to see, we think the tide must turn for the better before long."

General E. S. Greeley, of The E. S. Greeley & Co.: "We have had large supply contracts since the first of the year, but they are about completed. This has made our business good so far, but I am not so sanguine that it will continue so in the next few months. In the 28 years that I have been in the business never, to my knowledge, have collections been so difficult. You have to be pretty careful with whom you deal, and cannot trust every would-be purchaser. Our trade is about equally divided between electric light, electric railway and telegraph and telephone supplies, but it is confined to the older companies. Our sales have been good, but collections, as stated before, are slow."

John E. McIntosh, of McIntosh, Seymour & Co.: "As the recent panic was simply a money scare, and not one of general business, I think that business will be good soon, for I think that before long money will be again plenty."

H. J. Gorke, manager of the Electrical Engineering and Supply Co., Syracuse, N. Y.: "We notice a marked improvement in both quantity and quality of orders received for electrical goods. We have been running our factory on three-quarter time for the last month, simply to reduce our stock, but will be obliged to begin to run full head the first of next week. From the present outlook we feel quite assured that we shall have a large trade in incandescent supplies this fall. We base our opinion upon a careful study and survey of our trade."

D. A. Andrews, Jr., vice-president of the Pettingell-Andrews Co.: "The outlook for business in our branch of the trade was never better. I do not think the electrical supply business has yet felt the hard times as have some other branches of the trade, but I consider that it is very necessary to be cautious and not to overload on stock or accumulate bad or doubtful accounts. While the worst of the storm is over, we are not entirely rid of it yet."

Russell Robb, treasurer of the Shawmut Fuse Company, Boston: "We believe the electrical business to be sound in itself, but suffering still from slow collections and the general disinclination to make any expenditures except those absolutely necessary. With the certain return of confidence and normal conditions we look for a period of activity and prosperity that will fully compensate for the dull times of the last few months."

Frank Ridlon, of Frank Ridlon & Co., Boston, Mass.: "Although business is at present quiet, I know of no electrical enterprises that have been abandoned. Factories are only shut down for want of ready cash, and the orders for apparatus and supplies are yet on file, to be filled as soon as confidence and credit are restored. Electricity is here to stay, and in my mind there is plenty of future business."

The Holizer-Cabot Electric Company, Boston, Mass.: "We look for a large business this coming fall and winter. Orders have kept us quite busy during the summer months, and are now coming in more rapidly. We believe that manufacturing in the electrical line has been overdone, and that the panic will have a healthy effect on it and kindred industries by weeding out the concerns who have cut prices below a living profit."

Philip W. Moen, general manager of the Washburn & Moen Manufacturing Co.: "The present condition of the electrical business is quite satisfactory, considering the troublesome times through which we have been passing. There is every reason to believe that there will be, with returning confidence, a good business for the fall and winter. Orders are coming in daily in good volume."

E. H. Cutler, manager of the Elektron Manufacturing Co.: "I have no doubt that, as the general business of the country improves, the electrical business will show a corresponding improvement. A few years ago everything in the electrical line was generally considered a novelty or a luxury, but at the present time electrical apparatus is firmly established as a necessity in many industries of trade. I do not believe that the present condition of general business warrants the expectation of a large volume of business in the electrical line in the near future, but I believe it warrants expectation of a gradual and continuous improvement and increase."

Lucius T. Stanley, of the Cutter Electrical and Mfg. Co.: "Construction business of the better class was never better in this part of the country than at present, with

large promise for the future. Not a day passes but that we are asked to estimate for this class of work, most of it isolated plants, from dynamo to the lamp. There is also good trade in the specialities. This has been the case through the entire period of the depressed financial condition of the country. I consider the prospect for fall business excellent."

H. C. ADAMS, of the Philips Insulated Wire Company. "Since the 1st of September there has been a change for the better, but collections are still very tight. Prices are good; that is one consoling feature. Our trade this year does not compare with '92, and I do not anticipate any immediate great change for the better."

W. C. BRYANT, manager of the Bryant Electric Co.: "It has been very gratifying to note that the electrical people in general have weathered the storm safely up to the present time, and have shown that they were equal to the fight. The present outlook is good, confidence is slowly returning, and orders are more plentiful than they were three weeks ago. The recovery will be slow but sure, and those houses that pass this storm safely may be considered good for credit for some time to come. We shall probably not have the same activity this fall that we had last, but by the first of January I think confidence will be nearly restored and people will be willing to stock up with staple goods."

F. W. DAVIS, secretary of the Perkins Electric Mfg. Co.: "Business with us is unsteady, and I fear will continue to be fitful for some little time to come, though there are slight indications of improvement. We do not find that our friends are suffering from an excess of stock. There will, therefore, in the natural course of events, be a more steady demand for goods from the manufacturers, as the causes for the recent depression in industrial lines cease to exist; but, being neither a prophet nor the son of a prophet, I will not venture a prediction as to when we may look for a normal condition of affairs. I feel tolerably certain, however, that in time, and we hope before many months, there will be an active demand for all kinds of electrical apparatus."

F. C. BILLINGS, of the Billings & Spencer Co., Hartford: "The electrical trade in our line is very quiet. We have contracts for our commutator bars with several of the large manufacturers, but are holding back deliveries on these contracts. The street railway people are apparently buying as little as possible for necessary repairs."

J. G. BIDDLE, a director of Queen & Company: "Our business being largely with colleges, the present depression has not affected us so much as some others. We feel very hopeful that trade in general will show material improvement soon, which is partly evidenced by large orders already received as the result of our World's Fair Exhibits."

C. M. WILKINS, of the Partrick & Carter Company: "It affords me pleasure to have the opportunity of stating that the present condition of the electrical business, so far as we are concerned, is good, and the outlook bright. Within the past 30 days sales have greatly increased, and the class of supplies being ordered shows that the construction branch of the trade is undergoing a revival. The most gratifying feature of the improvement is easier collections. Remittances and orders from Montana, Washington, Utah, California, Colorado and points in the Southwest, which have heretofore been considered as laboring under financial embarrassment, would indicate a change for the better in those sections where the distress was perhaps most keenly felt. Remittances from these States during the past month have been very satisfactory, and inquiries regarding prices for contemplated orders are being received daily."

A. L. REGISTER, of Pepper & Register, Philadelphia, Pa.: "Owing to the hard times we were not permitted to complete the amount of work we had contracted for, thus reducing somewhat our year's business. We, however, see considerable business ahead for the future and quite a good deal for the immediate future."

THOS. YEARSLEY, of the Yearsley-Shinn Electric Co., Phila.: "We are working full time, and expect to continue to do so, but don't look for an increase in our business this fall, as compared with last. Many manufacturers who had intended lighting up are waiting for some definite tariff legislation."

JOHN A. BRILL, vice-president of the J. G. Brill Co.: "The prospects for electric railway business, I think are admirable, dependent, of course, on the condition of the money market. If the improvement, which has been extensive in the last few weeks, continues I consider the outlook almost as encouraging as it was this time a year ago."

CRAIG B. ARNOLD, treasurer of the Arnold Electric Manufacturing Company, Chester, Pa.: "We find business generally in very good condition; that is, we are manfacturing to our full capacity, and our outside construction work is more than we can possibly attend to. We have been running Sundays on outside work to catch up. We could increase our business probably threefold had we the capacity and manufacturing facilities to handle it. Tightness of the money market makes it difficult to collect and settle accounts."

FROM THE WESTERN STATES

C. D. CRANDALL, of the Western Electric Company: "Business is slightly improving, but I do not look for many new enterprises this fall. We have experienced a very noticeable change in the last two weeks, more especially in way of business secured than in financial matters. With a little more time, and confidence restored, money should again become steady."

C. SORLEY, of the Pumpelly-Sorley Storage Battery Co.: "An improvement is noticeable, but money still tight. This I do not expect will prevail after a little. I believe that after the Sherman repeal bill is law, everything will right itself immediately. Business seems to be very brisk."

GEO. A. MCKINLOCK, of the Central Electric Company: "I think the commercial affairs of our country have touched bottom; we can't go any lower, so that any change must, of necessity, be for the better. I do not look for a revival of business until the policy of the Government regarding the tariff is determined. While the electrical business is not immediately affected by this consideration, the disturbance of business, as a whole, can be felt among us. As a matter of fact, I do not look for a return of former conditions at all. When affairs steady themselves, it will be found that many enterprises of unsound basis have gone out of existence. One thing is gratifying, however, and that is that money asked for by many firms to tide them over their difficulties of the past few months will not new be needed. The next general Congress, when the tariff can be definitely settled, will bring us to a sound basis once more; but nothing else will, in my opinion."

F. S. TERRY, of the Ansonia Electric Company: "Business is mending, though slowly, as it will for some time. Collections are somewhat better; but I do not look for a rush of business until some time in the future. For a year or two, at least, it looks now, things will be settling. At that time business will be more stable, more conservative. The panic has been beneficial in one respect—that it has wiped out many schemes that had no merit whatever. In our own business, I do not look for any great improvement in the way of new plants. In many places where new installations were contemplated, the depression in agricultural circles will prevent investment, and this will be felt. The early spring, however, should bring a better condition."

WM. TAYLOR, of Taylor, Goodhue & Ames: "Business has assumed a decidedly healthier tone. Brightening skies have removed the barriers that stood in the way of new installations and increases to light and power plants, and the postman and telepgraph messenger boy have renewed their old time habits of crowding our desks with orders and requests for estimates on machinery or material. If we can value a lesson when it is taught us, our crafts will be strengthened in whatever points they appeared unseaworthy, and the storm will not prove an evil unmixed with good."

A. S. TERRY, of the Star Electric Lamp Company: "In our business, the present not being the busy season, we are very well satisfied with the amount of business we are getting. It is fully equal to what we were doing last year at this time. From present indications I should think money would be comparatively easy in say 60 or 90 days, and shall then look for an increased business in all electrical lines."

THOMAS J. STACEY, treasurer of the Electric Appliance Co.: "In a general way collections are improving rapidly, and are considerably better than they have been for the past month or two. In other respects business has not improved to such a marked degree although September promises to be a better month than the two preceding it. The indications are that the improvement in business will be gradual, but that the winter's business will be considerably below the general average and far below that of last year, and trade will undoubtedly not resume its normal condition until late into next spring."

E. R. STELLINUS, of the Sterling Boiler Co., Chicago: "It seems to me that one would be blind not to see the radical and distinct improvement that has taken place in the condition of trade during the past three weeks. In our business this has been evidenced by a more active inquiry for material, etc., than we have noted since early last spring. Companies who have depended upon the sale of their bonds to make needed improvements have now resumed negotiations with their brokers looking toward the sale of their securities, and are meeting with a degree of consideration that two months ago would have been thought impossible. Legitimate ventures and all betterments that have been undertaken by responsible people will be pushed to early completion, and it will only be the windbags who will suffer. I think the outlook is encouraging, and before many months have passed business will have resumed the even tenor of its way, and we will all be pushing forward more vigorously and actively than we have ever before, all the better by reason of the ordeal through which we have passed."

GEO. A. FORD, president of the Ford-Washburn Storelectro Company, Cleveland, O.: "We are offered plenty of orders which in ordinary times we would be glad to fill, but from the present conditions of things we prefer to let alone. As soon as the financial condition of the country becomes settled I am satisfied the electrical business will boom as in the past."

C F. LUNKENHEIMER, president of the Lunkenheimer Company, Cincinnati, O.: "As regards our business, we are pleased to state that matters are gradually assuming a normal condition, and we have no doubt that before long our industry will again be thriving as of old."

CHAS. F. THOMPSON, of the Lane & Bodley Co.: "This has been a credit panic, and as electrical enterprises, both private and municipal, rely largely on investment capital for their purchases for new plants and extensions, and the past few years having been notable for increase of bonded indebtedness of municipalities in this section with a revolting feeling of the public mind, only time can cure the patient and provide capital for the business."

A. J. ADAMS, of the Commercial Electric Co.: "General depression has greatly decreased both the sale and production of electrical goods, and many manufacturers have allowed their stock on hand to reach an unusually low point. This last condition implies a rapid resumption of manufacturing operations on any considerable increase in orders. The tendency to reduce transactions to a cash basis has been an advantage, as electrical business has too frequently been done on long and uncertain credits. Few manufacturing industries are more dependent upon the general prosperity of the country than the electrical. The ability to interest capital in central station, street railway and power transmission plants, and the activity of the building and general manufacturing industries, are most essential to a ready market for electrical goods. The returning desire of capital for investment and the gradual resumption of general manufacturing industries indicate a largely increased market for electrical goods in the near future."

THE ROSE ELECTRIC LIGHT SUPPLY COMPANY, St. Louis, Mo.: "There is a general disposition to delay the purchase of electrical apparatus, although in many instances the parties are in pressing need of additional electrical machinery. This is caused mainly on account of the manufacturers and dealers insisting on selling on almost a spot cash basis, where formerly these goods were sold on extended payments. As there are now signs of financial improvement, a little more liberality and less conservatism on the part of the manufacturers and dealers would soon have a very beneficial result in the way of bringing in desired orders."

The Outlook for the Future.

BY GEO. F. PAGE.

It seems to me that the present outlook of the electrical industry is most excellent.

Notwithstanding the great advance that has been made during the last half dozen years in the art as well as in the science of electricity, the unoccupied field is so vast that great achievements are sure of accomplishment within the next very few years.

The production and transmission of electric currents for heating and cooking purposes seems to me to bid fair to equal in a very short time what has already been done in the transmission of electric current for power, if indeed it shall not equal the business of incandescent lighting.

The transmission of electric currents over long distances by means of the multiphase system is still in its infancy. The Concord Land and Water Power Company of this city is now engaged in the installation of a plant to transmit electric currents generated by water power over long distances for the purpose of lighting, heating and cooking.

That company already has in hand a very large business assured, and within the next three months its plant is expected to be in complete operation, thus using a large water power upon the Merrimac River which has heretofore run to waste. Undoubtedly many other water powers are to be employed in a similar manner during the next decade.

To every one who has visited or may yet visit the Columbian Exposition it must be apparent that the Exposition itself could not have existed in anything like its splendid achievements without the aid of electricity, and that the Exposition must result in a great impetus to the electrical business.

Concord, N. H., Sept. 15, 1893.

Direction of Future Electrical Progress.

BY THOMAS D. LOCKWOOD.

In my opinion the electric business is generally in a resting condition, and I do not look for any radical advance in the immediate future, either in further invention and discovery, or in utilization.

At the same time I should expect that a steady, if not rapid, increase will, during the next five years, take place in the extent to which all of the principal electrical appliances will be used; as well as a pronounced improvement in the character and excellence of construction in all branches of electrical application.

I look for a very marked increase in lighting residences by incandescence on the transformer plan; and also expect a renewal of interest in the employment of accumulators for transit purposes.

It seems to me also that large electric locomotives

will be brought into use to a considerable extent for yard and station tunnel work; but it does not appear likely that the electro-motor will be much used for regular train work until some practical way is devised for enabling the trains to carry their power along with them.

In telephony I expect to see a more widespread public appreciation of the fact that telephone exchange companies are not in the business of renting telephones to subscribers, but in that of selling a good article of telephone service to customers; and that such companies will continue to extend the good work of improving plant and methods of operation, and of laying underground conductors.

In telegraphy I am disposed to look for a continued advance in the employment of machine currents, which I think will gradually supersede the voltaic current; and in offices which are not sufficiently large to sustain their own power plant I consider that current can profitably be drawn from certain classes of street lighting mains, and modified to any required character by transformers and commutating or other devices.

Boston, Sept. 15, 1893.

Laboratory Notes.—III.

BY LIEUT. F. JARVIS PATTEN

THE MOTOR-DYNAMO AND LABORATORY CIRCUITS.

Many young engineers and many electricians of experience would undertake experimental work were it not for the cost of the thing, which so often appears too serious a matter.

Many good ideas are thus abandoned as mere paper sketches or a sort of "wonder if it would work idea" unless some one more fortunately situated is given a chance to put the idea into practical form.

To render the investigation of ideas by experiment easier, to show that it is a far less expensive undertaking than is generally supposed, is the purpose for which this article is written. I shall try to show the experimenter how to go to work, how to arrange his shop, and how to get the conditions he requires without a laboratory that costs a fortune to establish and maintain.

In this line of work it is surprising how much can be done with little and how wide a field of research is opened to investigation with a plant of comparatively small significance and cost.

Experimental work, or at least the means and arrangements for conducting it, can be generalized to the same degree as any other system of industrial application, but the idea is prevalent that no step can be taken without a costly dynamo for this kind of current, another for that, and a big steam engine to drive them both.

The truth of the matter is, the equivalent of these various forms may be had in a modest way ever ready at hand in a workshop of small dimensions, without driving belt or shafting and with small outlay for cost of plant and maintenance.

If you have at hand one form of energy, mechanical or other, it is easy to change it to any desired form of nearly equivalent value, so it will rest with the experimenter to chose whether it would be better for him to take mechanical power from a line of shafting, and so drive a small dynamo to obtain current, or to take the electric energy directly from a circuit in the building or street where he locates, or, lacking both these chances, to use a battery of some form, primary or storage, according to circumstances.

Of all these, decidedly the most convenient is the ordinary incandescent light circuit of the building, if there be one; say a low tension direct current of 110 or 220 volts.

Do not, however, suppose that even with such a convenience at hand you will escape the necessity of having a dynamo machine of some kind, for however unpretentious your workshop may be such a machine is quite indispensable to your work. Such a machine as you require need not, however, be costly. This machine, which will be referred to as the motor-dynamo, is an essential feature and starting point of an electric workshop, for from such a machine as I shall here describe various forms of current can be derived at a moment's notice with but little modification or mechanical change of the machine.

The first thing to consider is, what kind of a machine to select for a motor-dynamo. This does not involve the question of cost so seriously as one might think, for many types of machines will answer the purpose, and there are now many second hand dealers who have quite a wide range of machines from which to select, and they can be had for a small part of their first cost.

The greatest amount of electrical energy that you will require at any time will, therefore, be a guiding factor—whether two kilowatts will satisfy your requirements or twenty is the point to be determined. If you do not contemplate the use of heavy currents nor any extensive plant, then probably the latter amount will be unnecessarily large; for small currents and light work three kilowatts or about 4 h. p. will doubtless be ample.

If you have a 110-volt circuit this would mean an armature current of about 28 amperes. In the uses you would make of your machine you could allow 35 or even 40 amperes to flow for a short time without injury to the circuit of the armature; with a 15-kw. machine taking at full load about 70 amperes from a 220-volt circuit I have often allowed 100 amperes to flow for a considerable time without damage to the machine; but you must have reliable fuse plugs in these circuits, as they are the safety valves of your engine and should properly be placed in every circuit of the shop at the point where it branches from the mains.

A limit of 30 amperes at 110 volts is a convenient one for small experimental work, and assuming this, you will select a 4-h. p. direct current dynamo or motor of which to make your "motor-dynamo," or you can improvise such a machine at a moderate cost that will serve your purpose quite as well.

To understand how to make such a machine, as well as what sort of one to buy if you go to the dealers, you must have a clear idea what you are going to require of it, and how it is going to be made to meet your demands.

The first evident use of the motor-dynamo is a mechanical one; it will be used as a motor to drive the lathe for turning small work, boring holes and fitting small parts, and it may be required to drive other electrical devices, using it as you would a line of shafting for that purpose. In view of this it will, of course, be placed where it is conveninent for mechanical use, and so arranged that the belt can be easily thrown on or off. Used as a dynamo for giving current, its position in the shop is of little importance, as the leads will be so arranged that current can be taken from them at any convenient point.

This latter use as a generator of electric currents is the principal one for consideration. As such it will run free as a motor and give its current to an external experimental circuit, generally in some form other than that derivable from the house mains. This use, as a motor-transformer, will determine the selection of the machine as regards its form and mechanical construction. Thus you want an alternating current, and multiple currents, i. e., biphase and triphase currents, and they must be obtainable at various voltages and current strengths.

(*To be continued.*)

Notation, Symbols and Abbreviations at the International Electrical Congress.

At the International Electrical Congress held recently at Chicago, a committee consisting of Prof. H. S. Carhart, president, and Prof. W. E. Ayrton, Dr. E. Budde, Prof. G. Ferraris, Prof. E. Hospitalier, Dr. A. Palaz and Mr. A. Siemens, members, was named by the Chamber of Delegates of the Congress to consider the question of electrical notation, and reported as follows:

"The Committee on Notation, composed of representatives of different nations, proposes the following resolution for adoption:

"The Chamber of Delegates recommends the international employment, for practical use, of the notation, symbols and abbreviations comprised in the following table:

"Chicago, Aug. 24, 1893."

SYMBOLS FOR PHYSICAL QUANTITIES AND ABBREVIATIONS FOR UNITS.
Recommended by the Committee on Notation of the Chamber of Delegates of the International Electrical Congress of 1893.

Physical Quantities.	Symbols.	Defining Equations.	Dimensions of the Physical Quantities.	Names of the C. G. S. Units.	Abbreviations of the Names of the C. G. S. Units.	Practical Units.	Abbreviations of the Practical Units.
Fundamental.							
Length	L, l	.....	L	Centimetre.	cm	Metre.	m
Mass	M	.....	M	Mass of one gramme.	g	Mass of a kilogramme.	kg
Time[1]	T, t	.....	T	Second.	s	Minute; hour.	m; h
Geometric.							
Surface	S, s	$S=L.L$	L^2	Square centimetre.	cm^2	Square-metre.	m^2
Volume	V	$V=L.L.L$	L^3	Cubic centimetre.	cm^3	Cubic-metre.	m^3
Angle	$\alpha\ \beta$	$\alpha=\frac{\text{arc}}{\text{radius}}$	A number.	Radian.	.....	Degree; minute; second; grade.	
Mechanical.							
Velocity	v	$v=\frac{L}{T}$	LT^{-1}	Centimetre per second.	cm : s	Metre per second.	m : s
Angular velocity	ω	$\omega=\frac{v}{L}$	T^{-1}	Radian per second.	.....	Revolutions (turns) per minute.	t : m
Acceleration	a	$a=\frac{v}{T}$	LT^{-2}	Centimetre per second per second.	$cm : s^2$	Metre per second per second.	$m : s^2$
Force	F, f	$F=Ma$	LMT^{-2}	Dyne.	dyne	Gramme; kilogramme.	$g^* : kg^*$
Work	W	$W=F.L$	L^2MT^{-2}	Erg.	erg	Kilogrammetre.	kgm
Power	P	$P=\frac{W}{T}$	L^2MT^{-3}	Erg per second.	erg : s	Kilogrammetre per second.	kgm : s
Pressure	p	$p=\frac{F}{S}$	$L^{-1}MT^{-2}$	Dyne per square centimetre.	dyne : cm^2	Kilogram per square centimetre.	$kg : cm^2$
Moment of inertia	K	$K=ML^2$	L^2M	Gramme mass centimetre squared.	g : cm^2		
Magnetic.							
Strength of pole	m	$F=\frac{m^2}{L^2}$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$				
Magnetic moment	$\mathfrak{M}$	$\mathfrak{M}=ml$	$L^{\frac{5}{2}}M^{\frac{1}{2}}T^{-1}$				
Intensity of magnetization	$\mathfrak{I}$	$\mathfrak{I}=\frac{\mathfrak{M}}{V}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
Field intensity	$\mathfrak{H}$	$\mathfrak{H}=\frac{F}{m}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
Flux of (magnetic) force	Φ	$\Phi=\mathfrak{H}S$	$L^{\frac{3}{2}}M^{\frac{1}{2}}T^{-1}$				
Magnetic induction	$\mathfrak{B}$	$\mathfrak{B}=\mu\mathfrak{H}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
Magnetizing force[2]	$\mathfrak{H}$	$\mathfrak{H}=\frac{4\pi NI}{L}$	$L^{-\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	.....	.....	ampere-turn.	A-t
Magnetomotive force	$\mathfrak{F}$	$\mathfrak{F}=4\pi NI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$				
Reluctance (magnetic resistance)	$\mathfrak{R}$	$\mathfrak{R}=\rho\frac{L}{S}$	L^{-1}				
(Magnetic) Permeability	μ	$\mu=\frac{\mathfrak{B}}{\mathfrak{H}}$	A number				
(Magnetic) Susceptibility	κ	$\kappa=\frac{\mathfrak{I}}{\mathfrak{H}}$	A number				
Reluctivity (Specific magnetic resistance)		$\nu=\frac{1}{\mu}$	A number				
Electromagnetic.							
Resistance	R, r	$R=\frac{E}{I}$	LT^{-1}	.....	.....	Ohm.	ohm
Electromotive force	E, e	$E=RI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-2}$	.....	.....	Volt.	V
Difference of potential	U, u	$U=RI$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-2}$	.....	.....	Volt.	V
Intensity of current	I, i	$I=\frac{E}{R}$	$L^{\frac{1}{2}}M^{\frac{1}{2}}T^{-1}$	.....	.....	Ampere.	A
Quantity of electricity	Q, q	$Q=IT$	$L^{\frac{1}{2}}M^{\frac{1}{2}}$	.....	.....	Coulomb; ampere-hour.	C; A-h
Capacity	C, c	$C=\frac{Q}{E}$	$L^{-1}T^2$	.....	.....	Farad.	F
Electric energy	W	$W=EIT$	L^2MT^{-2}	.....	.....	Joule; watt-hour.	J; w h
Electric power	P	$P=EI$	L^2MT^{-3}	.....	.....	Watt.	W
Resistivity (Specific resistance)	ρ	$\rho=\frac{RS}{L}$	L^2T^{-1}	.....	.....	Ohm-centimetre.	ohm-cm
Conductance	G	$G=\frac{1}{R}$	$L^{-1}T$	.....	.....	Mho.	mho
Conductivity (Specific conductance)	γ	$\gamma=\frac{1}{\rho}$	$L^{-2}T$				
Coefficient of induction	L, l	$L=\frac{\Phi}{I}$	L	....	....	Henry.	H

The C. G. S. magnetic and electromagnetic units have not received special names. They will be designated by the general name "C. G. S. units."

No abbreviations.

1. The International Bureau of Weights and Measures has established an important distinction in the notation of time, according as it refers to the *epoch* (date of time or day) or the *duration* of a phenomenon. In the former the reference letters are used as indices, and in the latter they are on the same line with the numbers; for instance an experiment began at $2^h\ 15^m\ 46^s$, lasted 2h 15m 46s, and ended at $4^h\ 31^m\ 32^s$. This method is to be recommended.

2. N is the number of windings, L the length of the solenoid generating the magnetizing force.

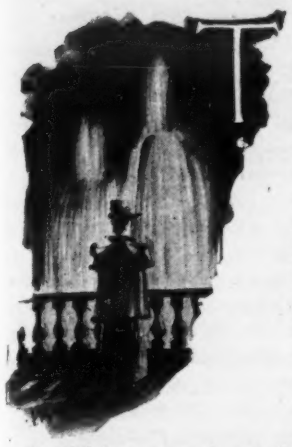
On the proposition of Mr. W. H. Preece, and after discussion, the Chamber of Delegates adopted the following resolution:

"Resolved, That this report be received as the report of the committee dealing with the subject, and that it be printed as an appendix to the general report of the Chamber."

Chicago, Aug. 25, 1893.

The General Electric Company at the World's Fair.

BY JOHN M'GHIE.

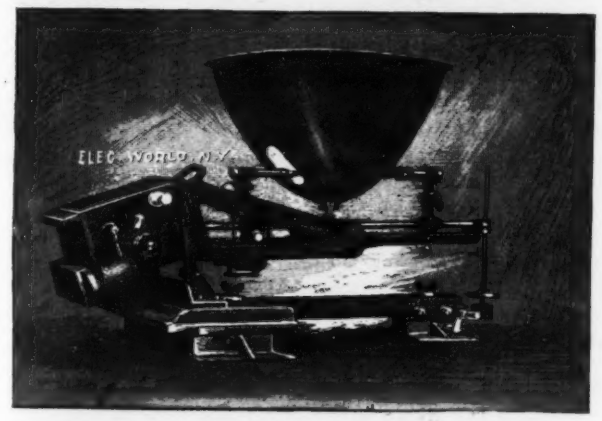


HERE have been given on several occasions in the past in the columns of The Electrical World detailed descriptions of parts of the magnificent and comprehensive exhibits which the General Electric Company has made at the World's Fair, both within the walls of Electricity Building and elsewhere at the Exposition. But whereas hitherto only detached portions of this exhibit have been described, it is now the purpose to consider it as a whole.

It will be remembered that when the Exposition was first projected the General Electric Company was invited to participate; and, feeling that it occupied the position of the largest electrical company in the world, it decided to make the largest and most varied display of all at the Fair. That it has succeeded in getting together a really striking and comprehensive exhibit even the most prejudiced will admit.

It was only late last fall that the space now occupied by the General Electric Company was allotted to it; but the work of installation was pushed forward energetically, and the exhibit was ready at about the time the Fair was declared open. The entire central part of the Electricity Building is occupied by its display, which covers the entire space in the transept from the east to the west door, and stretches down the aisle on either side. On either hand, immediately under the galleries, the space adjoining the central areas was also assigned to the General Electric Company, thus securing to it over one quarter of the ground floor of Electricity Building, and at least one-seventh of the entire available space.

In addition to its exhibit, in the proper acceptation of



A FOUNTAIN ARC LAMP AND PROJECTOR.

the term, the work which the General Electric Company has done in connection with the Exposition forms in itself a superb display transcending in diversity and splendor everything previously attempted at any other exposition in this country, or, indeed, in any other. This includes the wonderful electric fountains, the Intramural Railway, the pier movable sidewalk, the entire Exposition motor equipment, the electric launch service, the battleship Illinois, the greater part of the outside arc lighting, the lighting of the great interior of the Manufactures and Liberal Arts Building and other minor applications.

The fountains have already been described and illustrated (The Electrical World, Jan. 21 and May 13, 1893). It suffices us to say here that they constitute one of the greatest and most pleasing attractions at the Fair in the evening, and form a souvenir which every visitor will carry away to live in his mind for the remainder of his days. Although their operation has not been so perfect as might have been desired, yet they have proved a great centre of interest, and modifications in the method of working them having been effected, now permit of their operation with the maximum of light and the maximum of water. The result is beautiful almost beyond conception; and, as the great streams of water rise and fall, suffused with the iridescence of a thousand hues in combination, the delighted people congregated on each side of the great basin, in front of the Administration Building, and upon the canal bridges, express their appreciation in very audible tones.

The next important work undertaken by the General Electric Company—the Intramural Railway—was fully described and illustrated in The Electrical World of May 6. This road now runs almost all around the grounds. Constructed after many of the Fair buildings had been erected, and compelled by the condition of things to be as unobtrusive as possible, its course is not only circuitous, but has more grades and curves in its short length than any other elevated railroad of a similar length in the world. Its northern extremity is just north of the north end of the great Manufactures and Liberal Arts Building, where it passes in a loop over the north branch of the Lagoon, the station at this point giving access to both sides of the Lagoon and the Fisheries and Government buildings. Thence the road passes north through the group of foreign buildings, close to the German, Russian, Haytian, French and Swedish buildings, then east of the Art Palace, passing close to the Vermont, Massachusetts, Connecticut, New Jersey and Iowa State buildings. It then turns to the west, passing along the north side of the grounds, giving a fine view of the State buildings, as well as the Art Palace.

Turning to the south at the northwest corner of the grounds, a glimpse is obtained from the cars of the curious Esquimaux village; and at 57th, 59th and 62d street entrances the road connects with the stations immediately over the gateways. In passing to the west side of the grounds, the passenger has a fine view of the

DETAIL OF INTRAMURAL TROLLEY.

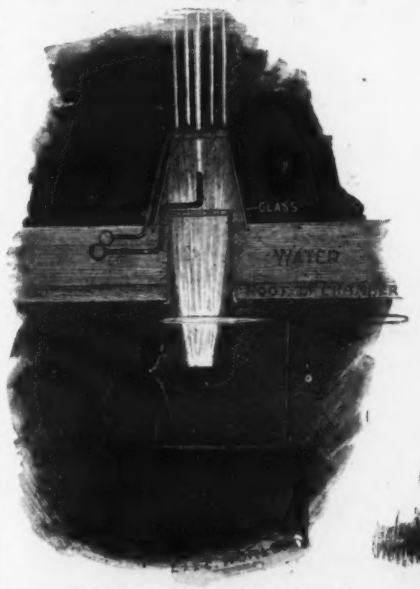
California Building, Woman's Building, Horticultural Building and Choral Hall. The track continues behind the Service Building and over the roof of the Transportation Building, connects directly at the joint station with the Chicago South Side Rapid Transit Railroad, or "Alley L," and thus provides good facilities for travel over the South Side.

From this point the road passes over the tracks of the steam roads, and connects at the terminal station with all the roads that enter the Fair Grounds; then around the west end of Machinery Hall to a station between the Colonnade and the Stock Exhibit Pavilion, whence a fine view, limited by the great dome of the Illinois State Building and the Art Palace, may be had through the heart of the Exposition to the north end of the park.

Thence the road turns southeast, past the Agricultural Building, the Great White Horse Inn, and the Cliff Dwellers to the power house of the Intramural Railway, where the electricity for the operation of the road is generated.

The road then takes a northerly direction and passes between the Forestry Building and the Ethnological Building, where there is a station for the accommodation of visitors to these two interesting exhibits, thence between the Dairy and the Shoe and Leather exhibits, until the Krupp exhibit is reached. The station at this point forms the southern terminus, situated in the loop which surrounds the Indian School exhibit.

Considerable interest in this road is manifested, not only by the engineering and electrical fraternity, but also by the lay public, which has not allowed to pass by this excellent opportunity of seeing and witnessing what is the highest degree of perfection yet attained in electrical railway work, and the only solution of the rapid transit question not open to the usual objections. The officials of the Intramural Railway are instructed to receive all visitors and show them all that is to be seen, and it may safely be said that no visitor to the

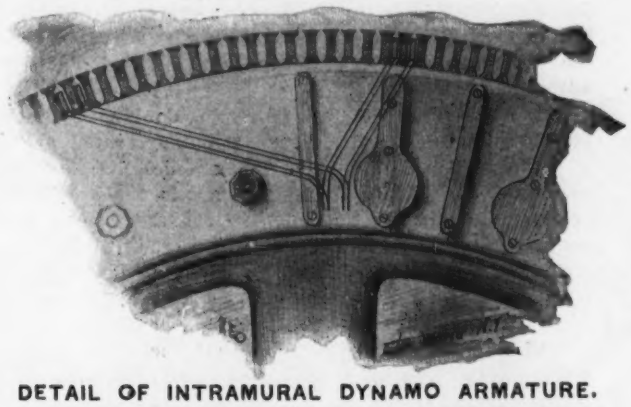


FOUNTAIN PROJECTOR.

Exposition omits to visit the railway in general and the power house in particular.

This power house contains the most complete single exhibit of moving machinery at the Exposition. Upon its floor the General Electric Company has congregated samples of its multipolar generators of various capacities, both belt driven and direct connected, and practical railway men are thus asked to consider the merits of both systems. The place of honor is, of course, given to the great 12-pole, 2,100-h. p., 1,500-kw. direct connected multipolar generator, which towers a colossus of a new industry, a tamed Titian of traction, above the lesser machines which are grouped on either side of it. To refresh the memories of The Electrical World's readers, the dimensions of this machine, given in a former article, are repeated:

Weight of field magnets	80,000 lbs.
" " armature	73,600 lbs.
" " commutator	12,400 lbs.
" " dynamo, complete	181,000 lbs.
" " shaft and hub	56 tons
" " flywheel	85 tons
Diameter of generator	15 ft. 0¼ in.
Breadth of generator	3 ft.
Diameter of armature	10 ft. 6 in.
Breadth of armature	3 ft. 3¼ in.
Diameter of flywheel	24 ft.
Breadth of flywheel	2 ft.
Thickness of rim of flywheel	1 ft. 10 in.
Diameter of commutator	7 ft. 6 in.
Diameter of shaft	2 ft.



DETAIL OF INTRAMURAL DYNAMO ARMATURE.

Another machine in this power house which merits attention is the 750-kw. multipolar dynamo, directly connected to a Lake Erie engine. With this combination the entire twelve trains on the road, running during the 18 hours of service, were operated for some little time without aid from any other machine. This showing is phenomenal, and speaks highly of the efficiency of the design and construction of both dynamo and engine.

Facing the great dynamo is the enameled slate switchboard framed in mahogany. It is composed of five panels, one for each machine, each panel containing all the instruments necessary for the control of the machine to which it belongs, i. e., triple pole switches, shunt rheostats, ammeters, automatic circuit breakers, lightning arresters, lightning switches, etc. The circuit breakers are of the new design of the General Electric Company, and are provided with automatic resetting devices, which close them electrically. With this electrical reset, all or any desired number of circuit breakers in the station can be reset at once. The generators are adjusted so to run in perfect harmony as exactly to divide the load in proportion to their relative capacities—a nice problem with generators of such varied sizes and types.

The transportation service is effected by trains running at four-minute intervals, each train consisting of a motor car and three trailers; the trains weighing 63 tons each, seating 280 people, and the cars being of the same length as those generally used on elevated roads—about 45 feet from end to end. The weight of these trains, as compared with a train drawn in the usual way by a locomotive, shows a saving of about 20 tons dead weight.

It has been found that the amount of power required to run this road was considerably less than that provided, but the General Electric Company, preferring to subject itself to no chance mishap or unforeseen contingency, put in an excess of power. As at present

GROUP OF THE McMONNIES FOUNTAIN.

equipped the road is equal to any emergency. Its operation is as perfect as electrical and engineering skill could devise, and the public desire expect. On July 4 it carried not less than 63,000 passengers, and during the month of June over three-quarters of a million.

The pier movable sidewalk was devised to convey passengers from the boats to the grounds. It runs from end to end of the pier, and breaks into a loop at either end. The walk moves continuously in one direction, and is divided into two sections, the outside moving at three miles an hour, the inside section at six miles an hour. No difficulty is experienced in stepping on to the outer running platform from the stationary one, and another step places the passenger on the faster

moving platform where he takes his seat and is carried along to his destination, when he alights with as little difficulty as he took his place. The track is elevated a few feet above the level of the pier, and is surrounded by a stationary platform railed in. Every thirty-fifth truck is equipped with two General Electric motors. Each truck is 12 feet 6 inches long, having a wheel base of 5 feet 9 inches. The gauge of the track is 45 inches, and the truck wheels 18 inches in diameter. The width of the platform is 36 inches. The six-mile-an-hour platform is also composed of trucks 12 feet 6 inches long, and carries seats for the passengers. This is propelled by means of a flat band of steel four inches deep and half-inch thick, which, resting on the rims of the truck wheels, moves along twice as rapidly as the trucks themselves and carries the faster platform with it.

The motors are "G 30" four-pole, double reduction motors of the General Electric Company, rated at 15 h. p. each. The conductor is strung under the platform on special coil insulators, and contact is made with an ever-running trolley dependent from the truck. The endless steel band serves as a return circuit. The total weight of the train is 918,000 pounds, and the 10 motor trucks 12,000 pounds each, making a total weight of 1,038,000 pounds. Three hundred h. p. are provided to run this train, but 200 h. p. suffice. The road is operated by the Multiple Speed and Traction Railway Company.

The next great feat of the General Electric Company is the lighting of the interior of the Manufactures and Liberal Arts Building with its arc lamps. The immensity of this building, in which might be placed several regiments of cavalry and infantry, is such that any plan of lighting dependent upon upright supports was doomed to failure. Still it had to be lighted, and the perspective restored at the same time. Mr. Stierlinger, the designer of the fountains and the tower, elaborated a scheme which has proved once more his claim to originality of conception and power of design. The space to be lighted is the interior of a building, which in the clear measures 1,276 feet long by 380 feet wide, and the task outlined has been successfully accomplished. Pendent from the great girders of the roof are five great coronas of iron suspended by steel cables, and carrying immense arc lamps arranged in star form on the outer edge. The largest corona measures 75 feet across, and is suspended in the exact centre of the building. This is flanked on either side above the central aisle by four others, the diameter of which is not less than 60 feet. The greater corona carries on the inner and outer star points 102 10-ampere arc lamps, each of 2,000 c. p.; the smaller coronas are each hung with 78 lamps of the same candle power—in all 414 arc lamps with an aggregate of 828,000 c. p., blazing from a height of 140 feet from the floor over the stupendous collection of wonders within the stately walls. The lamps are thoroughly insulated by passing the lamp cables through rubber insulators on the davit arms. They are run on circuits of 50 lights each. As auxiliary to this great lighting feat there are also a number of arc lamps used for the lighting of the galleries and lateral aisles. The total number of General Electric arc lamps employed in the illumination of this building is 1,098—as many as would be needed to illuminate the streets of some great city. The lamps are operated from the Thomson-Houston arc light plant in Machinery Hall. The ironwork of the coronas was done by the Pittsburgh Bridge Company, of Pittsburgh, Pa., and never were electroliers of proportions so huge made before in the history of the fixture industry.

The other open air exhibits of the General Electric Company are the electric launches and the great search light. The popularity of the former is attested by the very palpable profit daily accruing in the coffers of the operating company. They skim silently and swiftly over the placid waters of the basins, canals and lagoons, propelled by the unseen power, which emits no smoke nor noise of steam. They are always crowded evenings as well as in the broad day, and are resorted to as a means of viewing the imposing architectural beauties from the water level as opposed to the view from the second story which is obtained from the Intramural road. There are 50 of these little electric waterflies, carrying hidden from view of the passengers the batteries and the necessary motors. The charging station is south and east of the Agricultural Building. Here the launches are moored, the connections made and the charging from the group of four No. 60 Edison dynamos in Machinery Hall proceeds silently through the night, until each has received enough of the fluid pabulum to permit it to run for 11 or 12 hours without another meal—i. e., about 40 h. p.-hours of electrical energy. The motors are of a design especially made by the General Electric Company to be run in connection with the storage batteries of the Consolidated Storage Battery Company in the launches of the General Electric Launch Company. The electric launch, when first placed upon the lagoons, was a mere experiment in this country; to-day it is an every day object, no longer exciting surprise, and soon we shall expect to see as many electric launches disporting themselves on the waters of the Hudson or Schuylkill as are to be found darting up the reaches of old Father Thames by Richmond way.

In the great search light the General Electric Company has a show card which is as unrivaled in its own field as are the other features mentioned. This immense eye is 10 feet 6 inches high to the upper side of the ventilator, and has a total weight of 5,500 pounds. The reflecting lens mirror of the Mangin type is 60 inches in diameter—as perfect a spherical concave mirror as can be made by human hands and perfected machinery. This mirror, 6 feet 3¼ inches at the edge and 1-16 of an inch at the centre, weighs 700 pounds. It is mounted at the end of the huge drum, and looks upon the automatic six-foot arc lamp, which carries a positive carbon 22 inches long and 1¼ inches in diameter, and a negative carbon 15 inches long and of similar diameter. The maximum amount is 200 amperes and the luminous intensity of the lamp 90,000 to 100,000 candles, which, it is calculated, is increased in reflection to an estimated intensity of 375,000,000.

This great search light is erected in the colonnade between the Agricultural and Machinery buildings and its splendid beam shoots up over the canals between the Electricity and Manufactures buildings, passes over the Illinois Building, making it appear of spectral whiteness, and loses itself against the obscurity beyond. This search light has no points to receive from the excellent search lights which Germany has sent over. It is of home production, and in perfection of operation equal, if not superior, to anything in its line made here or elsewhere.

Many other search lights of General Electric manufacture are shown in Electricity Building and on the battleship, each and all attesting the superiority of American ingenuity and workmanship.

The work of General Electric motors is evident all through the Fair. During its construction these motors were universally used in place of the steam engine for hoisting the great iron girders and trusses into place, for running sawmills, pipe cutting and threading machines, planers, sewerage and water pumps, painting machines, etc. The entire motor system of the World's Fair, comprising every motor used by the Exposition, between 1 and 135 h. p., has been furnished by the General Electric Company, and these useful and busy little machines are met with in every one of the architectural wonders of the Fair.

In Machinery Hall is to be found the great heart of the General Electric system as laid down at the Fair. The plant installed there may be divided into the low pressure incandescent system and the arc lighting system. The principal feature of the former is the two 400-kw. multipolars, set with a triple expansion engine. The efficiency of these generators is attested by the work similar ones have done in the New York station. The engine designed by Mr. J. C. Henderson for 800 h. p. at maximum economy will easily give 1,500 h. p. under emergency. The Chicago Edison company is to have a duplicate of the set shown here, and it is calculated to maintain light over an installation of 25,000 lamps. Near to this machine—the largest type of direct connected, direct current lighting generator—is shown the smallest—a four-pole 2-kw. generator driven by a Case engine. In addition this plant comprises a 45-kw. multipolar directly driven by a G. G. compound Willans engine. From this is distributed the current for the incandescent lights around this plant, and the search lights in the Music Hall, Casino and Electricity Building.

Immediately in front of these machines are four 150-kw. General Electric bipolar dynamos, giving current for the electric fountains and the launches. And a little to the side is a switchboard, which is perhaps the most compact of its kind ever constructed. It carries all the switches for the different machines just enumerated, 4,000 ampere switches being used for the large 400-kw. generator, ammeters, voltmeters for each dynamo circuit, ammeters and potential indicators for each feeder circuit, of which nine run from the board. The lower left hand corner of the board is used for a no current circuit breaker, which, used on the feeder for the launches, prevents the reversal of the dynamo by the united electromotive force of the batteries.

At the western end of this plant is the arc lighting exhibit of the General Electric Company, consisting of 27 Thomson-Houston and six Excelsion machines, all of standard design. From the former run the circuits for the great coronas in the Manufactures Building, and the latter are used for the Horticultural Building. Both plants also supply current for considerable outside lighting. The wires from the machines are carried to the 40-circuit arc switchboard, which is a remarkable piece of switchboard design, perfect in operation and workmanship. In the rear of this are two marble boards on which are mounted the controllers for the Thomson-Houston arc machines. The entire plant is driven by a low speed engine with Corliss valve gear.

The north aisle of Machinery Hall is spanned by the electric hauling crane from the Morgan Iron Works, operated by means of seven General Electric motors. It is the completest electric traveling crane ever built, and is under easy control by the operator in the cage at one end. Near the centre of the aisle are two 135-h. p. General Electric motors belted to the countershafting.

Coming now to Electricity Building, the exhibit proper of the General Electric Company will be easily accorded the palm for variety and extent. It covers the entire field of electrical research outside the special regions of telegraphy and telephony.

The south centre space is devoted to a complete exhibit of Thomson-Houston and Edison motors, all fully equipped with the accessory apparatus for their stopping, starting and speed regulation. Between the two lines of motors are the special motor applications, such as factory trucks, launch motors, electric drills with flexible shaft, derrick and ventilating fans. The derrick is always a centre of attraction for a large crowd. It is of five tons capacity and fitted with a lifting magnet of 2,000 pounds. A platform capable of carrying 14 to 16 people stands beneath the magnet. Placing the magnet on the keeper attached to the platform, and energizing it allows the motor on the derrick to lift the entire load. As soon as the current is shut off from the magnet the platform drops.

Beyond the motor exhibit is the railway exhibit of the company, consisting of its multipolar ironclad railway generators of the belted types, the new panel switchboards devised by the General Electric Company, and several trucks carrying the most modern motors. Among these is the new type G. E. 800 motor on a Bemis truck, the type W. P. 30 on a Taylor truck with Genett air brake, the type W. P. 50 on a Robinson radial truck, and the type L. W. P. 20 as used on the Intramural Railway on a Jackson & Sharpe truck with the Griffin Car Wheel Company's wheel. The latter truck is shown complete with its air-brake equipment as supplied on the Intramural Railway by the New York Air Brake Company. On the showboard covering the reverse of the switchboard is shown a diagram of car wiring as practiced by the General Electric Company in its series parallel system. There are also shown a complete set of overhead parts as used in the construction of the present day. Over the entire exhibit extends a double track, double bracket trolley system with a crossing at right angles. The entire construction, ornamental in character, is intended to appeal to those in the community who have an antipathy against the unsightliness of overhead wires.

In the east centre space is the merchant marine exhibit of the General Electric Company, including direct connected generator, four-winch hoist, search light projectors and all the electric light fittings peculiar to merchant marine or men-of-war service. The Stanley-Kelley two-phase system with General Electric generator specially designed for this service is also here shown, as well as alternators of direct and belt-driven types. Toward the centre of the building in this space is shown a collection of models and special apparatus designed by Prof. Elihu Thomson, of the General Electric Company.

In the north centre space is collected the Edisonia of the company. The Jumbo machine after 11 years of continuous service was taken out of service and kindly loaned to the General Electric Company by the New York Illuminating Company for this display. It would be interesting to know the total earnings of this machine, gross and net, for the stockholders of the New York Illuminating Company. To the north of the Jumbo is a complete display of the three-wire system with all the material needed therefor. Adjoining this is a set of machines supplying current for the quadruplex telegraph service of the Western Union and Postal Telegraph companies reaching out from the World's Fair to all the various points accessible without retransfer. A switchboard in connection with this plant enables the telegraph company to take off positive and negative potentials of any desired degree up to 350 volts.

The lamp exhibit of the Edison lamp factory is the first complete commercial exhibit ever attempted of the incandescent lamp. It is remarkable in showing the number of varieties of lamps that are in commercial use at the present day, there being 2,500 commercial lamps in the exhibit, no two of which are alike. The patent exhibit is also of interest. The space at the north end contains an exhibit peculiarly fitted as a background of the Edison lamp exhibit, being an enormous fan studded with over 1,300 incandescent lamps, which has already received our attention.

In the west centre space is the power transmission and mining exhibit of the General Electric Company, in which is shown in full the three-phase system of power transmission, including a very interesting series of transformations of energy. In the centre of the exhibit stands a deep mine triplex pump of 500 gallons capacity for a lift of 650 feet, moved by a 100-h. p. 220-volt electric motor. The motor derives its energy through the transformations of fuel, boiler pressure, engine and dynamo with transmission from Machinery Hall on the Edison three-wire system. The triplex pump delivers the water under the head mentioned against a Pelton water wheel, which, at 750 revolutions, delivers its power to the armature of a 35-kw. three-phase electric generator, the armature of the generator being on the same shaft as the paddles of the Pelton wheel. From the three-phase generator the current is conducted to a set of step-up transformers, having ratio of 20 to 1 and transmitted across to the mining space on three No. 18 wires, where step-down transformers reduce the potential to 110 volts. At this potential the current is used to light 500 incandescent lamps arranged equally on each of the three branches of the three-phase circuit; to three series of arc lamps arranged two

in series with resistance across each of the three legs of the three-phase circuit; and to a series of three-phase motors from 3 to 15 kilowatt capacity. In addition to this system is shown a synchronizing system, the alternating current generator driven by a direct current motor being on one side of the exhibit space, the alternating current motor being located on the other side of the exhibit space. The direct current motor driving the alternating current generator is in fact a motor transformer having on one side a direct current commutator and on the other side the three-phase commutator, and is used as either a direct current or three-phase motor, or as a motor transformer at the will of the operator. The transmission of high potential by the three-phase system and the transformation into low tension direct current for distribution for general service are here very successfully accomplished.

In the rear of this exhibit, on the west side of the building, but in the same exhibit space, is shown mining apparatus, including locomotives from 20 to 80 h. p., from 18 to 36 inch gauge, pumps of various styles and capacities, hoists, electric air compressors, reciprocating and prospecting drills. No other company on the face of the earth but the General Electric Company could get together an exhibit of so much special electric mining apparatus as is here shown, and none has a record of so satisfactory a service of similar types of apparatus.

The central space of the building is given up to a tribute to the Edison lamp. The tall shaft (illustrated in The Electrical World, April 8, 1893), extending almost to the roof, with a colonnade about the base, is here modeled after the German tower of Victory. The lower space about the colonnade is given to the exhibit of the Phoenix Glass Company, where they show exclusively crystal and glassware for electrical purposes. The entire lighting was designed and installed by the General Electric Company, the Phoenix Glass Company furnishing all glassware and fixtures. Above the cornice, studding the dome, between the exterior of the colonnade and the central shaft, are ribs of 5-c. p. incandescent lamps in various colors. Arising from the centre of this dome, 10 feet in diameter at the base, is the central shaft studded in vertical and zigzag lines with thousands of incandescent lamps that, in connection with commutating switches, located within the tower, can be made to flash and reflash in a manner that holds all spectators spellbound. Around the cap in incandescent lamps on each of the four sides are the words "Edison Light." Above the capital surmounting the shaft is a mammoth incandescent light made of thousands of pieces of crystal illuminated within by numbers of small-sized incandescent lamps, bringing out a beautiful play of prismatic colors. Surmounting the shaft and next to the ceiling in miniature incandescent lamps is the name "General Electric Company." By means of reactive coil this is dimmed one moment and the next moment caused to blaze out at full candle power.

Adjoining the central spaces and under the southwest corner of the gallery are the offices, reception and meter rooms of the General Electric Company. The meter room contains a peculiarly attractive display of decorative incandescent lighting, the ceiling and frieze being wrought out in lamps varying from 1 to 32 c. p., and of many varying colors. All classes of meters—chemical and mechanical voltmeters, ammeters, potential indicators, etc., used for isolated plants and for central station work—are shown. Many of the wattmeters are wired up to the loads throughout the Electricity Building, and lamps in this meter room, and thus the meters, acting under progressive loads, can be shown.

Under the southeast gallery space is shown the arc lighting exhibit of the General Electric Company. This consists of a working plant driven by a 200-h. p. Edison motor, the largest motor ever installed. It is directly connected to the shafting under the floor, from which are belted Thomson-Houston arc machines from 50 to 3 lamps capacity. The motor itself is so provided with field and starting rheostats that it can start safely under the heavy load of shafting, belting and machines, and the speed can be regulated to a nicety, the arc machines being kept at the speed necessary for proper regulation. The latest types of lamps, with lamp parts, machine parts and supplies of all kinds, including carbons, are shown in this exhibit.

Directly opposite, under the northwest gallery space, is located the isolated lighting exhibit of the General Electric Company. As a background a full line of house supplies, chandelier cut-outs, fuse blocks, cut-outs of all kinds, snap switches of all capacities, sockets of all classes, with switches of all capacities up to 1,500 amperes are artistically mounted on showboards. About the space are the most modern, direct connected engines and dynamos, triple expansion and compound. This exhibit alone is one worthy of a large manufacturing company.

About the central space hanging from L. J. Wing's suspension arms are four 4,000-c. p. arc lamps of highly ornamental character; also several ornamental lamp posts with special lamps.

Hanging on the trusses surrounding the exhibit are constant potential Knowles arc lamps of special finish suited to assembly halls, hotel hallways, corridors and large interior places of public concourse.

The work of the General Electric Company can also be seen in the Industrial Iron Works transfer table, Transportation Building, which has installed over 52,000,000 pounds of freight, including all the Pullman trains and large locomotives in this building. The transfer table is worked by a single W. P. 50 General Electric motor, the system of clutches and brakes being the work of the Industrial Iron Works. General Electric motors can also be seen in Machinery Hall, Transportation Building, Woman's Building and in several of the State buildings where they are used for the operation of passenger elevators of various types.

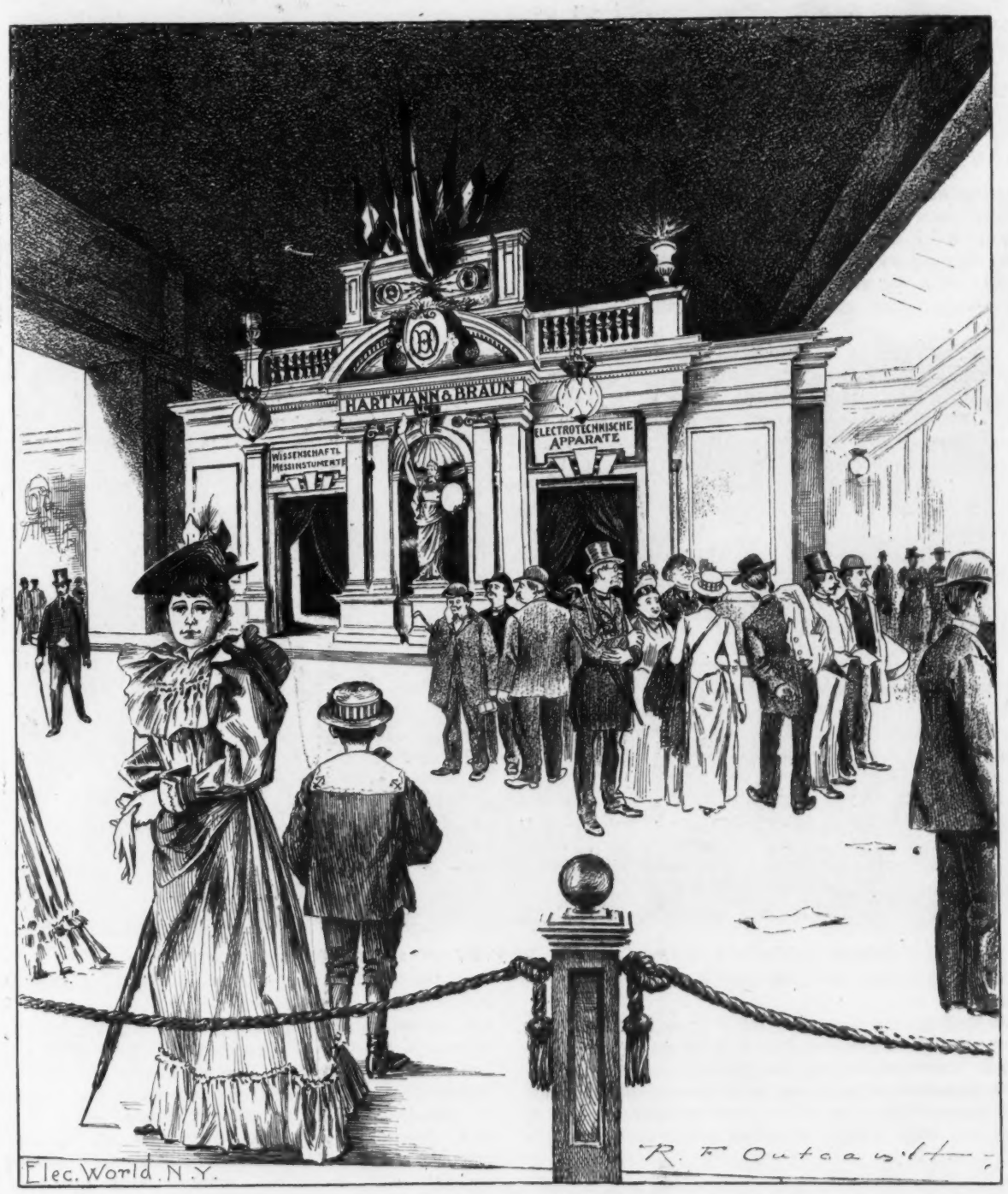
The equipment of the battleship Illinois has been effected by the General Electric Company complete after the usual high standard required by the Navy Department, and used by this company in the installation aboard all the cruisers of the new navy. Commencing with the ill-fater Trenton, every ship of the old navy in American waters, and every ship without exception of the new navy, has been equipped by the General Electric Company. The equipment aboard the Illinois consists of two cross compound vertical marine type Edison engines, directly driving 16 ironclad generating sets. As, however, there is no steam aboard this vessel, these sets are dummies, one of them being wired up to run as a motor and thus make a live exhibit of the dynamo plant. Within the bulkhead is located the true source of energy aboard the battleship. This consists of a motor transformer of 32 kw. capacity, one armature being wound for 500 volts, the other for 80 volts, the latter compounded for the usual percentage loss. As power for this ship is drawn from the trolley line of the Intramural Railway, at the north loop it was expected that the fluctuations in the potential would be somewhat violent. The motor is therefore provided with a unique controlling apparatus consisting of the wall controller as used on arc machines cutting in and out a portion of the field resistance of the motor. By this means a variation in the potential either way is easily compensated for. In adition to this, to overcome more violent fluctuations, there is provided on the dynamo end a storage battery. The latter is in parallel with the shunt winding of the dynamo so that ordinarily with the dynamo running at full potential the batteries are being charged, while in case of a large drop in potential the battery discharges, strengthening the series field and also suplying current to the lamps. The batteries also are used to supply the lighting system of the battleship direct through the intervention of a change-over switch. The latter course is resorted to for the night lighting of the ship after the railway plant has shut down.

On the battleship are two projectors, one forward, and the other aft on the bridge, both arranged for automatic control. Both projectors are 30-inch diameter, provided with horizontal lamp and diffracting lenses. In addition, two 30-inch projectors are located on the Casino and Music Hall respectively, serving to light the McMonnies fountain and the facades of the building surrounding the Grand Basin, as well as the dome of the Administration Building. The General Electric Company also makes, in connection with its merchant marine exhibit, a very extensive display of the search light projector, showing the various types that they make of focusing lamps an projectors.

It will thus be seen that this exhibit is by far the most extensive and most interesting at the Exposition. It is one which redounds to the credit of the great company which made it, and to the American energy, ability and talent of which it is the crystallization.

The Hartmann & Braun Exhibit.

In a previous issue the exhibit of a large American manufacturer of measuring instruments of precision was described in considerable detail, showing the perfection which that art has reached in this country. The Germans, however, have long had the reputation of doing exceptionally fine work in this line, and some of the displays in the German section of the World's Fair afford striking evidence of the correctness of this impression. The well known firm of Hartmann & Braun, of Bockenheim, is one of the largest makers of this class of apparatus, and its products may be taken as an example of the high standard in that country.



AN ATTRACTIVE PAVILION.

One of the most prominent places among the German exhibits in Electricity Building is occupied by the firm of Hartmann & Braun, of Bockenheim, Frankfort-on-the Main, and it attracts much attention for the furnishing of the pavilion as well as for the choice arrangement and, above all, the "technique" of the instruments exhibited.

The pavilion itself is an example of the refined, quiet taste of the Germans. Its ornamental facade, facing on the north side of the passage which divides the German section into two parts, is of white and gold. In a niche in the centre of the facade is the statue of Electricity, in whose right hand is the torch of science and whose left holds the laurel-wreathed portrait of the physicist, Weber. The interior of the pavilion is entirely covered

with green plush, against which background the finely finished instruments show to the best advantage, and is supplied with numerous tables, pillars, shelves and brackets of mahogany. The pictures of the six great men of the science after whom the fundamental units of the absolute system are named—Ampere, Volta, Ohm, Watt, Coulomb and Faraday—adorn the walls, while

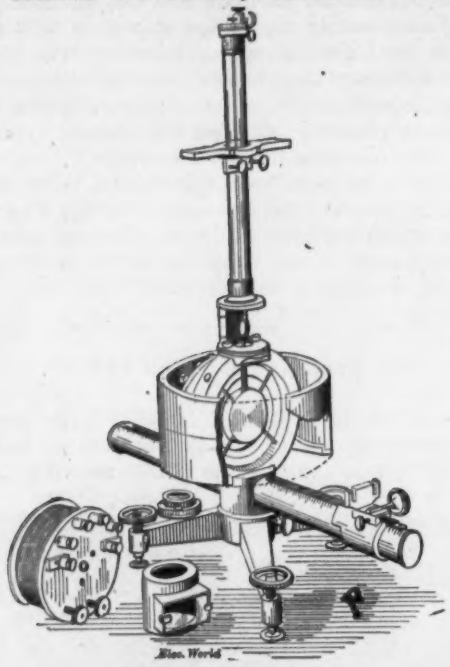


FIG. 1.—KOHLRAUSCH'S DIFFERENTIAL GALVANOMETER.

smaller bronze tablets carry the names of other great electricians. The place of honor under the canopy is occupied by the lately deceased Werner von Siemens. The instruments are placed partly in richly carved cases, partly on tables under glass covers, and partly on massive stone pillars and pedestals. The exhibit is in charge of Mr. P. Heitman, who ably represents the firm at the Fair.

We find on the northeast pillar a small Kohlrausch differential galvanometer, Fig. 1, with magnetic needle, mirror, controlling magnet and Braun's guard ring. The small, concentrated form, easy manipulation and high sensibility make this a favorite laboratory instrument. It is connected with a universal Wheatstone bridge for the

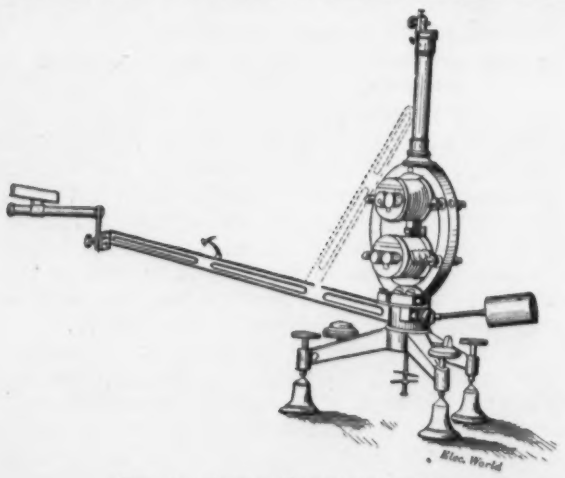


FIG. 2.—CABLE GALVANOMETER.

measurement of resistances of from .01 to 11,000,000 ohms. Close to it, on the next pillar, stands a large aperiodic mirror galvanometer of the Wiedermann type, but of greatly improved construction. It is provided with a bell magnet or, in place of this, with a ring magnet and Braun's guard and controlling ring of soft iron. The instrument is used, in connection with compensation apparatus and Clark standard cells, for the exact measurement of current and E. M. F. Between the two pillars is placed a large electromagnet with complete apparatus for the Faraday experiments, Waltenhofer's pendulum, a bismuth spiral for the measurement of magnetic fields and an arrangement for measuring the rotation of polarized light in a magnetic field.

On the third pillar stands a very sensitive cable galvanometer, Fig. 2, with Bruger's magnet, four coils and

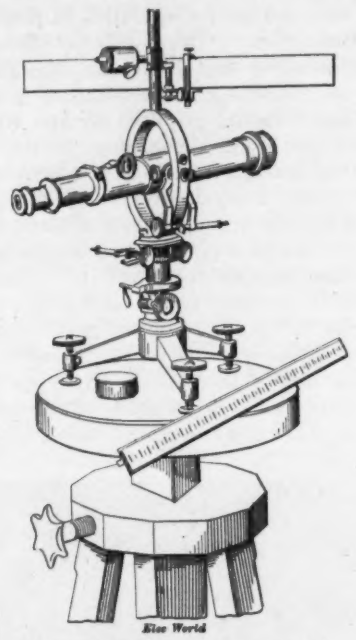


FIG. 3.—READING TELESCOPE.

variable damping and adjustable control magnet. This galvanometer, with the instruments to be found on the marble table, serves for the measurement of the insulation and capacity of cables. On the fourth pillar is placed a ballistic galvanometer with short cylindrical Weber magnets and adjustable damping for the determination of the capacity of cables. Between these two pillars (the third and fourth) is a Weber earth inductor for the determination of the earth's magnetic intensity. The earth inductor is connected to a large Weber ballistic galvanometer with long cylindrical magnets and adjustable damping. Telescopes and scales, Fig. 3, placed on adjustable solid oak Gauss stands are used for the observation of the deflections of the four galvanometers. Five different kinds of telescopes are exhibited, from the simplest with zinc stands and coarse hand adjustments to the finest with brass tripods and micrometer adjustments for all directions. The sharply defined images given by these telescopes are the result of the fine optical properties of the objective, the high polish, the accurately plane galvanometer mirrors, as well as of the excellent scales. These last are constructed of wood with paper scales, of plate glass, of celluloid and of white glass.

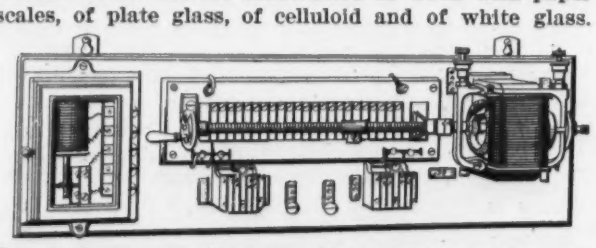


FIG. 4.—AUTOMATIC PRESSURE REGULATOR AND SWITCH.

The white glass scales are the best to use with reading telescopes.

Turning to the instruments on the tables and in the glass cases, we see a large photometer bar with Lummer-Brodhun comparison prism, a standard amylacetate lamp, a universal socket or stand for incandescent lamp use, and a rotating mirror for the examination of the candle power of the arc light at different angles. This apparatus is set up under a canopy which can be converted into a dark room for photometric measurements by means of heavy curtains. Above the photometer bar are: To the left, an automatic pressure regulator; to the right, an automatic storage cell switch, Fig. 4. Here, too, is the other apparatus neccessary for the running of an accumulator battery, together with maximum and minimum switches, voltmeters and ammeters, current direction indicators, commutators, etc.

In the corner case to the right are exhibited standards

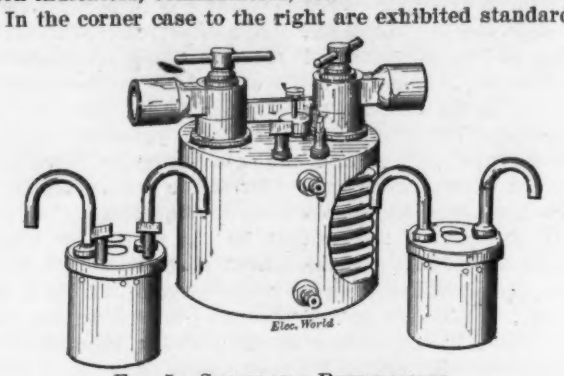
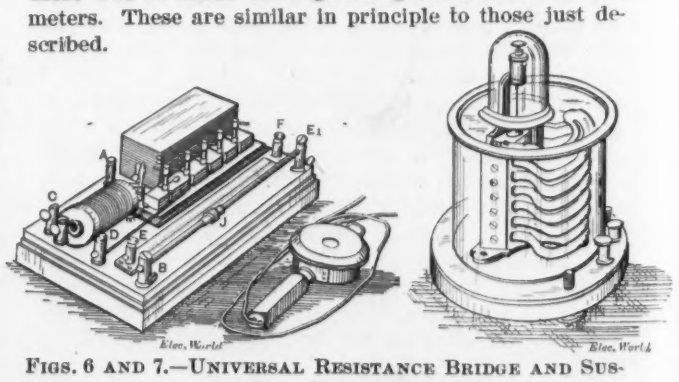


FIG. 5.—STANDARD RESISTANCES.

made according to the models of the Physical Technical Imperial Institute of Berlin, very accurate resistances, Fig. 5, of 1.0, 0.1, 0.01 and 0.001 ohm, with tubing, cooling apparatus for the maintenance of constant temperature, a small compensation apparatus. Clark standard cells,

STATUE OF ELECTRICITY.

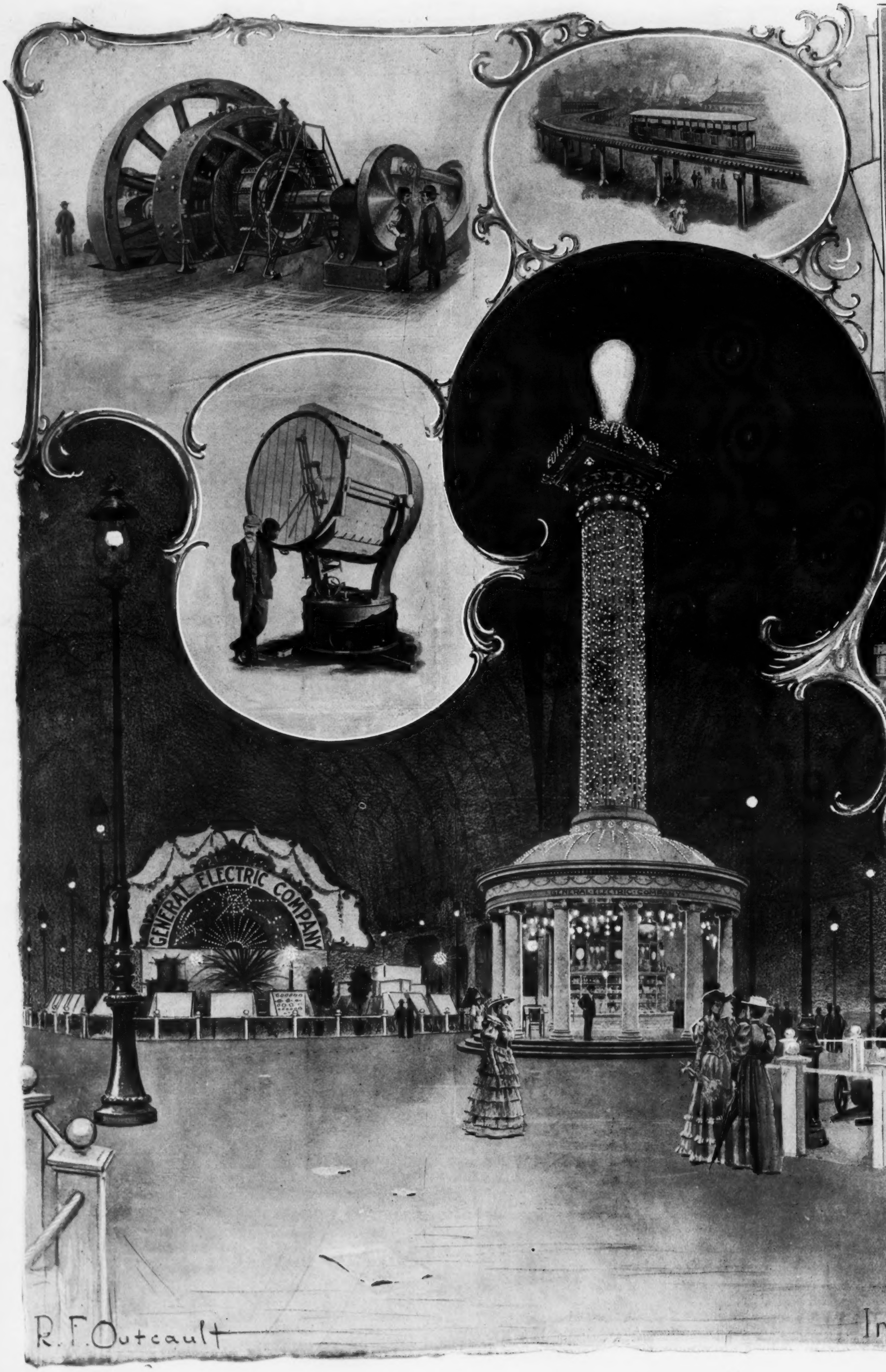
etc. To the right and left are small voltmeters and ammeters and milliammeters for medical purposes. Further along on the walls we see contact and signal voltmeters. In these a thin tube of sheet iron is drawn into a solenoid up to a certain point; as soon as the voltage exceeds the desired point the tube is drawn against a contact closing the circuit of a relay; by the aid of this relay an alarm bell is made to ring and either a green or red light made to glow. A similar proceeding takes place when the allowable minimum is reached. Other apparatus indicates irregularities in the voltage by ringing bells of different tone. Next to these will be found the registering voltmeters and ammeters. These are similar in principle to those just described.



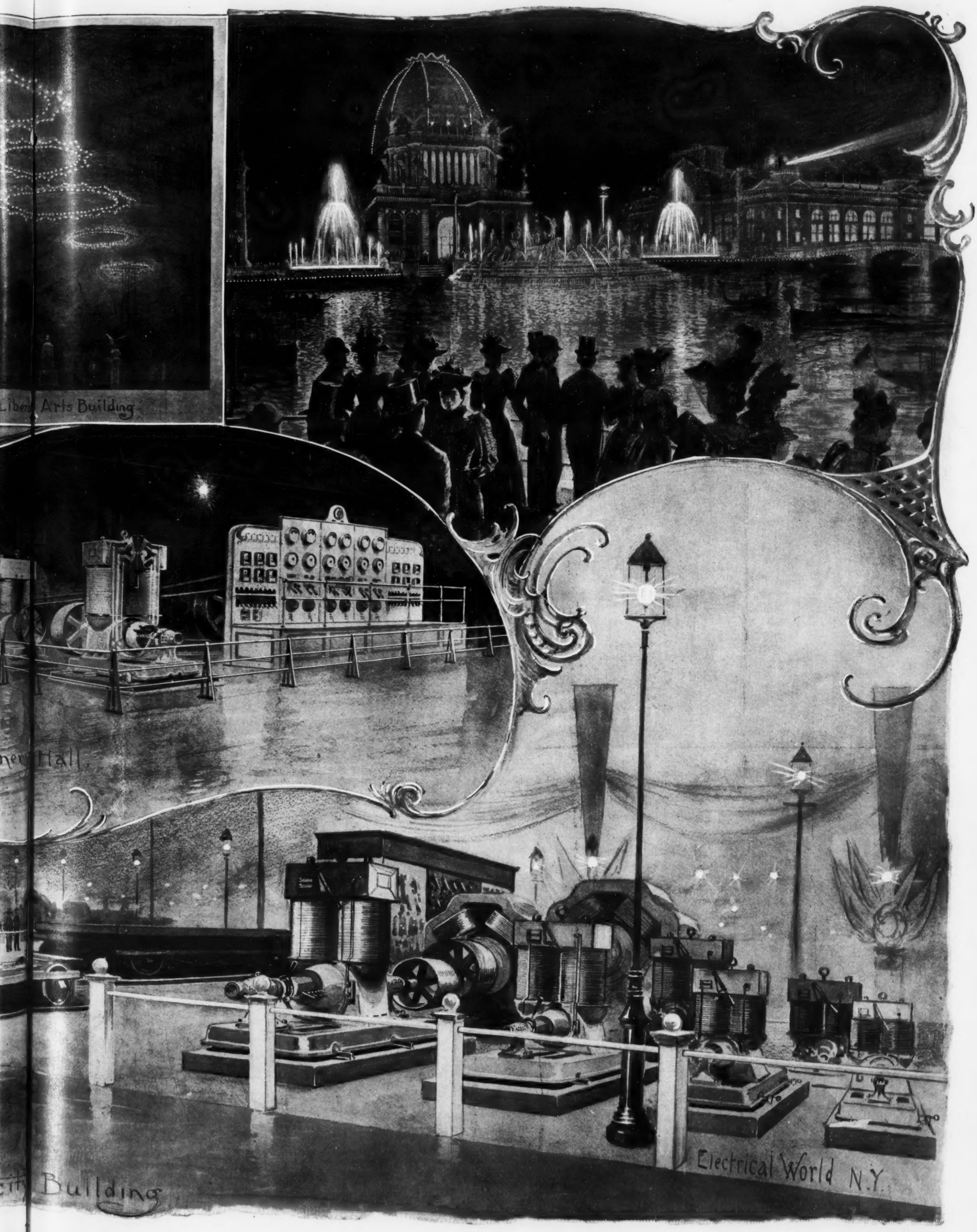
FIGS. 6 AND 7.—UNIVERSAL RESISTANCE BRIDGE AND SUSPENDED COIL GALVANOMETER.

Among the apparatus placed on a table are some simple school instruments which fill a long-felt want, including a very practical galvanometer, which can be taken apart in a minute and as quickly put together again; the less important parts—e. g., the astaticizing needle, the damper and one or more coils—can be left off. This instrument can also be just as readily converted into a tangent galvanometer. The next table

INTERIOR VIEW OF THE HARTMANN & BRAUN PAVILION.



Some Important Features of a Colossal



Colossal Exhibit at the World's Fair.

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contains several Kohlrausch bridges, Fig. 6, that are models of simplicity and usefulness. The one bridge is designed for solid conductors, the other for both solid and liquid conductors (resistance of batteries, etc.). In this latter bridge the measurement is made by the aid of a telephone, alternating currents being produced by a small induction coil attached to the apparatus. With both the bridges no calculations whatever are necessary, and the apparatus can be used by any one. The advantages of this apparatus seem already to be recognized by others, for the one bridge carries a card "Five times sold," similar notices appearing on many other pieces of apparatus.

The next table contains various kinds of Wheatstone bridges, some with stretched wires and sliding contacts, others with rheostats. The galvanometer used, Fig. 7, is a new, greatly improved form of Deprez galvanometer. The permanent magnets consist of seven horseshoe steel magnets with common pole faces of considerable length. By the use of a number of magnets a much stronger field can be obtained than by using a steel magnet. The current is carried in on two fine silver strips. Readings can be taken with either pointer or mirror and scale. Next to it is a differential galvanometer which may be used for various purposes, such as the measurement of the hot filaments of incandescent lamps.

In the finely carved main case may be seen specimens of the finest work that can be done in the line of instruments of precision, among which are large reading telescopes, large aperiodic mirror galvanometers, highly sensitive astatic cable galvanometers, Fig. 8, with Bruger's

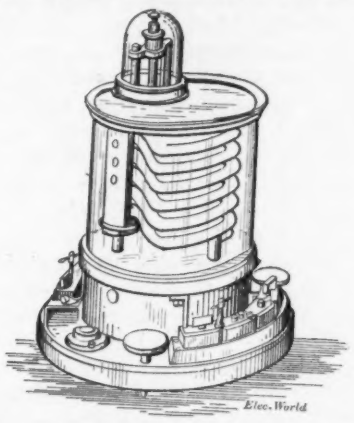


FIG. 8.—ASTATIC CABLE GALVANOMETER.

vertical double magnets hung by quartz fibres, new torsion galvanometers for current and E. M. F., wattmeters, and a collection of plane mirrors of glass and steel of the finest polish and greatest accuracy. For the determination of the specific resistance of metals, carbon, etc.,

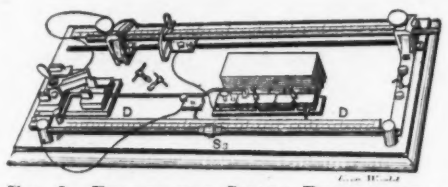
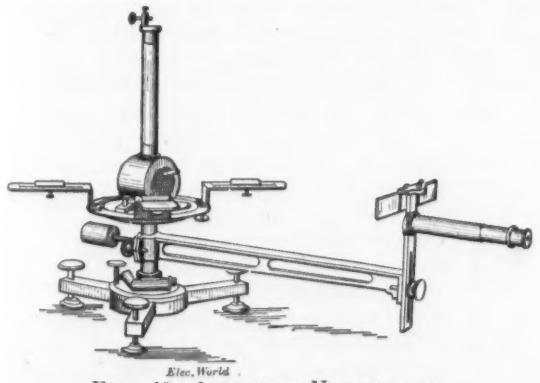


FIG. 9.—BRIDGE FOR SMALL RESISTANCES.

is shown a modified Wheatstone bridge, Fig. 9, in which the contact resistances are eliminated by double readings, the results being obtained without calculation. As a galvanometer is used a portable instrument, Fig. 10, called the "telescope galvanometer"; for, directly to the mirror galvanometer, by means of a movable arm, are fastened a little telescope and scale. This instrument combines

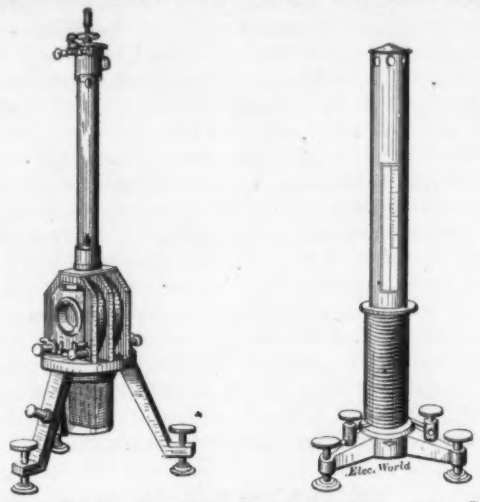


FIGS. 10.—INTENSITY VARIOMETER.

great portability with sensibility. For the measurement of current there are tangent coils and water, copper and silver voltameters.

The next piece of apparatus is of special interest. It is the instrument which serves to measure the number of lines of force and the leakage in a dynamo, the Lenard bismuth spiral. This was first brought into practical shape by Hartmann and Braun. It consists of a large number of turns of fine bismuth wire, bifilarly wound into a flat spiral of about 15 millimetres diameter and 1 millimetre in thickness. It is hence possible to place it in the small air gap of a dynamo. The property of bismuth of changing its resistance in a magnetic field is here made use of, so that from a mere measurement of resistance the number of lines of force of a given magnetic field may be determined. The figure shows a piece of apparatus designed for the determination of the permeability and coercive force of samples of iron. The bismuth spiral is placed at a. In the same case are various kinds of rheostats of great accuracy. These, like the spiral just described, form one of the specialties of the firm. The pyrometers of Prof. Braun, designed for the direct reading of temperatures up to 1,500 degrees C., are very interesting. The high sensibility of the apparatus is shown by the fact that at 1,000 degrees C. a change of 1 degree can be detected.

In a special case are placed the instruments made according to the designs of Prof. Kohlrausch, including tangent coils for absolute measurements, magnetome-

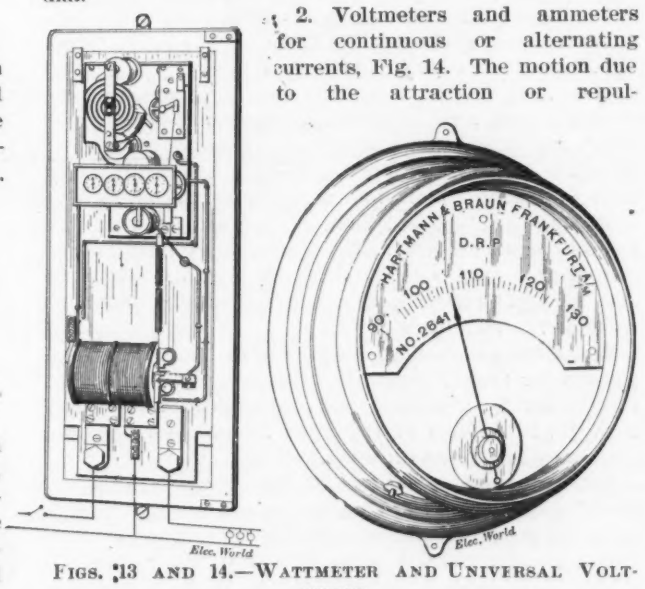


FIGS. 11 AND 12.--ELECTRO-DYNAMOMETER AND SPRING GALVANOMETER.

ters, variometers, galvanometers, dynamometers, Fig. 11, induction apparatus for the production of alternating currents, vessels for the measurement of the resistance of liquids, and cylinder bridges. To the right and left will be found the simple Kohlrausch spring voltmeter and ammeter, and a very conveniently arranged telephone bridge for the examination of lightning rods and conductors.

Turning to the instruments which in tastefully arranged groups adorn the walls, four different systems of voltmeters and ammeters may be distinguished.

1. The solenoid ammeter and voltmeter for continuous currents. In these an iron core (patented) is drawn into a solenoid, the movement being indicated on a dial.



FIGS. 13 AND 14.—WATTMETER AND UNIVERSAL VOLTMETER.

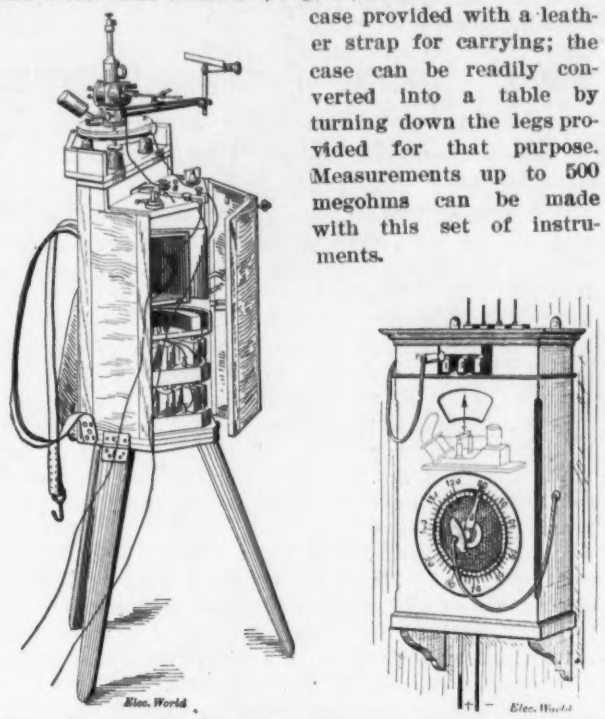
2. Voltmeters and ammeters for continuous or alternating currents, Fig. 14. The motion due to the attraction or repulsion of two very light cylindrical segments in a solenoid is communicated to a pointer. By changing the form and the relative position of the two iron segments the scale can be made as desired.

3. Hot wire voltmeters. Through the expansion of a thin metal wire heated by the current a light aluminium pointer is rotated about its axis in a very simple but effective way. This group can, of course, be used for either alternating or direct current.

4. Double solenoid ammeters and voltmeters, also to be used on direct or alternating currents. In fact, about the walls are hung over 100 ammeters and voltmeters, no two of which are the same.

The "watt-hour" meter, Fig. 13, must also be mentioned, different sizes of which, designed for different currents, are shown. The principle of this very correctly operating piece of apparatus is, briefly, the following: The current tends to turn the movable system of a wattmeter. A spiral spring of peculiar form, which opposes the movement, is at certain intervals drawn taut by a simple clockwork. The distance gained by the spring is communicated to a train of gears which is provided with an electromagnetic clutch. This clutch operates as soon as the strength of the current and the tension of the spring are such as to balance in effect. This operation is repeated once every minute. Some small motors of high efficiency which serve to drive small lathes and ventilators are also here shown.

As one leaves the pavilion by the exit which leads to the central large hall of the building he sees to the right and left a number of instruments designed for outdoor work; to the left magnetos, a small dynamo for blasting, etc. Next to these come two portable sets of apparatus for the measurement of the insulation of cables, consisting of telescope, galvanometer with three shunts, resistances, battery of 100 cells, connectors, keys and commutators. The whole set, Fig. 15, is contained in an oak case provided with a leather strap for carrying; the case can be readily converted into a table by turning down the legs provided for that purpose. Measurements up to 500 megohms can be made with this set of instruments.



FIGS. 15 AND 16.—PORTABLE INSULATION SET AND TELE-THERMOMETER.

Another piece of apparatus which attracted much attention is the telethermometer, Fig. 16. By means of this instrument the temperature of any distant place can be determined. One instrument can be connected with as many thermometers as may be desired; for example, the manager of a large establishment is able to read in his office the temperature of every room in his charge. To the right of the entrance is placed a handcart provided with all instruments necessary for cable laying; that is, with resistance bridges for conductor and insulation resistance, telephone galvanometer, battery of 100 cells, with connectors, together with an ammeter and voltmeter. On the wagon an arrangement is provided by means of which, in the shortest possible time, a tent for the protection of the instruments can be set up.

The pavilion, facade and the cases are brilliantly lighted by six large arc lamps of special construction, giving a very constant light, and by 36 incandescent lamps. In conclusion, it may be said that all the instruments are set up and connected so that they can be operated at any time.

The American Electro-Therapeutic Association.

The third annual meeting of the American Electro-Therapeutic Association commenced a three-days session at Apollo Hall, in Chicago, on Sept. 12. The officers are: Dr. Augustin H. Goelet, New York, president; Dr. William F. Hutchinson, Dr. W. J. Herdman, vice-presidents; Dr. Margaret A. Cleaves, New York, secretary; Dr. R. J. Nume, treasurer; Dr. William J. Morton, Dr. Robert Newman, Dr. G. Bretton Massey, Dr. Charles R. Dickson, Dr. J. H. Kellogg, executive council.

The morning session opened at 9:30 o'clock with a discussion and vote upon amendments to the constitution and election of new members. Dr. Augustin H. Goelet delivered an address on "Influences Governing the Progress of the Electro-Therapeutics," followed by reports of committees on standard coils, standard meters, static machines, constant current generators and controllers, electrodes, investigation of Dr. Newman's statistics in urethral stricture, and committee on arrangements. The balance of the morning was given to the reading of papers on "The Nutritional Effects of Statical Electricity," by Prof. William J. Morton, New York; "Electro-Medical Eccentricities," by H. Newman Lawrence, of London, England; "Graphic Study of Electrical Currents in Relation to Therapeutics," by J. H. Kellogg, of Battle Creek, Mich., and "Electrolysis in Tumors of the Bladder," by Robert Newman, of New York.

At the afternoon session Prof. W. J. Herdman, of Ann Harbor, Mich., delivered an address on "The Action of the Continuous Current Within the Living Tissues as Distinguished from the Local Polar Action," and Margaret A. Cleaves, of New York, followed with an interesting talk on "Metallic Electrolysis." The discussion on "What Are the Possibilities of Electricity of Fibroid Growths?" was then opened for discussion by Dr. J. H. Kellogg, of Battle Creek, Mich., and continued by Dr. Felice La Torre, Rome, Italy; Dr. Franklin H. Martin, Chicago, Ill.; Dr. A. Lapthorn Smith, Montreal, Canada; Dr. A. H. Goelet, New York; Dr. Margaret A. Cleaves, New York; Dr. G. Betton Massey, Philadelphia; Dr. George F. Hurlbut and Dr. George J. Engleman, St. Louis. An address by Dr. R. J. Nunn, of Savannah, Ga., on "The Treatment of Fribroid Tumors by Mild Electric Currents" closed the afternoon session.

In the evening a reception was tendered the officers and members of the Association and ladies at the Great Northern Hotel, from 9 until 11 o'clock.

THE ELECTRICAL WORLD'S DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO-PHYSICS.

Direct Currents from Alternating Currents.—In discussing the subject of the production of continuous currents for charging storage cells from alternating currents the Lond. "Elec.," Sept. 1, in an editorial, calls attention to the fact that, according to Fourier's theorem, a certain combination of simple periodic currents will give an absolutely steady current, showing that, theoretically at least, the desired result can be obtained very simply; all that is necessary is to produce a current which shall vary as the square of the sine of the time, instead of as the first power; two such currents having equal periods, but superposed in quadrature, will give a perfectly steady current.

Redressed Currents.—The "Elek. Zeit.," Aug. 11, reprints a paper by Mr. Pulluj, on the action of redressed electromotive forces, following the sine law, in a conductor with self-induction; the article is of a theoretical nature, and is, in part, an unfavorable discussion of recent statements made by Mr. Steinmetz.

Mechanical Analysis of Alternating Current Curves.—Referring to the instrument for mechanically analyzing curves mentioned in The Electrical World, Aug. 26, page 151, Mr. Boucherot, in "La Lum. Elec.," Aug. 12, describes and illustrates an apparatus for the same purpose, devised by himself independently of the other inventors.

High Tension Alternating Currents of Electrostatic Machines.—"L'Elec.," Aug. 5, publishes an abstract of a Phys. Soc. paper by Dr. Leduc, in which he shows that alternating currents thus produced have properties which are analogous, but not identical, with those of Tesla.

Recent Researches in the Electro-Magnetic Theory of Light.—"La Lum. Elec." publishes a somewhat extended serial on this subject, by Mr. Raveau; it began in the number of July 8, and is continued in the issues of July 29, Aug. 12, 19, Sept. 2, and is to be continued in subsequent numbers. The article is of a theoretical nature.

Mechanical Equivalent of Heat.—The recent electrical determinations by Mr. Griffiths, mentioned in the Digest Sept. 16, are described at some length by Mr. Blondin in "La Lum. Elec.," Aug. 5.

Effect of Magnetic and Electrical Stress on the Concentration of Solutions.—"La Lum. Elec.," Aug. 19, publishes a short article by Mr. Teurin on this subject, taken apparently from a Russian journal.

Influence of Gases on Contact Resistances.—In a note by Mr. Vicentini in "La Lum. Elec.," Aug. 12, are described some experiments, the results of which, however, do not appear to be of practical value.

The Residues of Polarization.—"L'Elec." Aug. 12, reprints an abstract of an Academy paper by Mr. Bouty on this subject.

The New Bolometer.—"La Lum. Elec.," Aug. 5, describes an improved bolometer of Mr. Crova.

MAGNETISM.

Rotary Magnetic Fields.—The article by Mr. Lucas, mentioned in the Digest Aug. 12, is continued in the issue of "L'Elec.," July 29, Aug. 19, and concluded Aug. 26; it is of a purely theoretical nature.

Magnetic Viscosity.—The article by Dr. Hopkinson and others on this subject, abstracted in the Digest last week, is reprinted in the "Elek. Zeit.," Aug. 4, much more fully than in the English journals; this description includes a number of curves and tables of data.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Practical Measurements of Alternating Currents.—The third lecture of Prof. Fleming (for the first and second see Digest of last week) is published in the Lond. "Elec. Eng.," Sept. 1. He explains in detail that when the circuit in which the power is to be measured is not inductive the power is equal to the product of the square root of the mean square values of the current and the voltage, as the impedance is then the same as the resistance, the current and the voltage being in step with each other; when the circuit is inductive, that is, when the current and the voltage are not in step with each other, the most practical and by far the best instrument to use is the electro-dynamometer, the fixed coil being placed in series with the circuit and the movable one—which must consist of only a few turns of wire, and must be in series with a non-inductive resistance—is connected as a shunt to the circuit in which the power is to be measured; the deflecting force will then be proportional at any instant to the product of these two currents; to standardize such a wattmeter, apply it to measuring the power in a known standard non-inductive circuit, at the same time measuring the volts and amperes with proper insruments; the important condition in this instrument is that the shunt circuit must be strictly non-inductive, the movable coil, cannot, therefore, have many turns, and if used with high voltages, much power is wasted, and very large external resistance is required; to overcome this the shunt current may be transformed, by the aid of a transformer, down to a suitable voltage, provided the transformer is large enough, for in lightly loaded transformers the voltage of the primary is exactly opposite in phase to that of the secondary. He also describes the Kelvin engine-room wattmeter, already noticed in these columns. These lectures, mentioned in the Digest last week, are abstracted briefly in the Lond. "Elec. Rev.," Sept. 1; the abstract contains no cuts.

The Effect of the Wave Form on Voltmeters.—Mr. Szapiro, in the "Elek. Zeit.," Aug. 11, proves mathematically that the reading of a commercial alternate current voltmeter depends also on the shape of the wave; from mathematical deductions he shows that in a circuit having resistance and self-induction, the same effective voltage will generate different currents, depending on the form of the wave; this does not affect voltmeters like the Cardew, but it does affect many others; as an example he takes the current from a Ganz machine, and shows that in the same voltmeter, with the same voltage and frequency, the current flowing through it will be 8 per cent. less than with a wave following a true sine law; therefore, a voltmeter, calibrated with sine currents, will, if used with currents not following the sine law, give too low values, in some cases so low as to interfere with the brightness of the lamps; to avoid this he claims that such instruments should not only be calibrated at the proper frequency, but also with the current of the machine with which they are to be used.

A New Volt and Ammeter.—Mr. Wilkins, in the "Elek. Zeit.," Aug. 4, describes a new volt and ammeter made by Hartmann & Braun, and intended for both alternating and direct currents; it consists essentially of a short solenoid, in the interior of which is a small iron ring, pivoted on an axle, being both eccentric and inclined to its axle; to overcome remanant magnetism the arrangement is such that the direction of the lines of force are changed as little as possible in the iron ring, which is accomplished by the ring moving either parallel to the lines or limiting its motion in the direction of the lines to as little as possible; in order to adapt it to alternating currents the length of the iron in the direction of the magnetic axis is made as short as possible; the tendency of the ring will be to move itself so that its axis corresponds with that of the solenoid. Tables are given showing the effect of remanant magnetism, neighboring currents, and the negligible difference between the readings for direct and alternating currents.

Measurement of Specific Resistance.—The Lond. "Elec. Rev.," Sept. 1, calls attention to a paper by Mr. Wien in the "Ann. d. Phy. u. Chem.," No. 6, in which he describes a new form of Hughes induction balance, with which measurements of specific resistance of metals can be made without comparison with a standard metal; the special features are that the operator is independent of faults of contact and thermal effects at contact; that the measurements are made on metals in their normal state before they are influenced by wire drawing; and that the specific resistance can be measured without determining a length.

Measuring the Insulation of Wires.—A portable apparatus for rapidly measuring the insulation of conductors is briefly described and illustrated in "L'Elec.," Aug. 19; it consists of the usual instruments arranged compactly in two small boxes.

Instrument for Testing Lightning Rods.—The "Elek. Zeit.," Aug. 18, describes and illustrates a compact, portable apparatus for measuring the resistance of lightning rods and their earth connections; the Kohlrausch method is employed, being modified in that an intermittent current is used instead of an alternating current, and produced by the turning of a crank, which, at the same time, moves the contact along the bridge wire; the complete connections of the instrument are given.

Wheatstone Bridge.—A lecture apparatus for explaining the Wheatstone bridge is briefly described and illustrated in "L'Elec.," Aug. 19; it consists essentially of a wire around the circumference of a circular disc and several radial movable arms making contact with it.

Clark Cells.—The papers of Dr. Kahle, mentioned in the Digest last week, are reprinted in full in the "Elek. Zeit.," Aug. 4.

Rule for Relation of Current to Magnetism.—The Lond. "Elec. Rev.," Sept. 1, gives the following rule of Prof. Daniell from "Nature": If a penholder be held in the right hand in the usual way it may be taken to represent the wire, and the direction of the flow of the ink as the direction of the current; if, then, the thumb be stretched a little across the penholder it will represent the magnet, the thumb nail being its north pole; (in other words, the motion of the thumb in stretching it will represent the motion of a magnetic needle below the wire). It also gives another by Prof. Holten used in Denmark: The outstretched right hand is put in the current with the palm turned toward the magnet and the fingers in the direction of the current; then the north seeking pole will be moved in the direction of the thumb.

DYNAMOS AND MOTORS.

Dynamo Shielding.—Mr. Christie, in the Lond. "Elec.," Aug. 25, describes in detail the tests made for the Greenwich Observatory to find whether the delicate magnetic instruments could be shielded from the dynamo which it is intended to use for lighting the Observatory. The output of the dynamo is two kilowatts; the shields used were made of one-quarter inch iron plate in the form of an arch with open sides; there were three of these, one over the other about three inches apart; they were placed over the dynamo with their open sides in the direction of the axis. The results indicate that the shielding effect is greater the nearer the shield is to the dynamo; the shields reduce the disturbance to one-seventh of what it is without them, the instrument being placed at a distance of 40 feet; the reduction of the disturbing effect was quite satisfactory, it being reduced to about one-half second of arc.

Sparking of Dynamos.—The article by Mr. Rechniewski, abstracted in The Electrical World, Aug. 26, page 146, is published in "L'Elec.," July 29 and Aug. 12, in a somewhat more extended form, containing some additional matter. This latter publication of it has been translated and reprinted in the Lond. "Elec. Eng.," Aug. 18 and 25. Besides our abstract mentioned above, the following may be of interest. He points out more clearly that a change in the current in the coils passing under the brushes will be accompanied by a sudden change of flux, which tends to cause sparking, the latter tendency being in direct proportion with the variation of the flux; to make this change of flux as small as possible upon a given change of current, find the number of ampere turns in the short-circuited coil, and, by laying this off in its proper place on the characteristic, the change of flux may be determined; it will be found that this change is very much smaller if it is located past the knee, which shows that, as far as sparking is concerned, it is best to have the magnetic circuit saturated; for other reasons it is better to saturate the armature rather than the field, and if the armature has teeth, to saturate these in preference to its core; smooth armatures spark less than toothed armatures if they are not saturated, which can readily be shown from their two characteristics, as explained above, but when the latter are saturated the advantage is in favor of the toothed armature, in which the knee is reached much sooner; that is, with much less excitation. He calculates the tendency to sparking, and finds that in both ring and drum windings it is four times as great when the windings are in series as when they are in parallel; for the large machines, therefore, drum winding in parallel is best under the condition that there is only one turn per coil; similarly he shows that the tendency to sparking is twice as great for the ring as for the drum armature, for an equal number of coils and for small machines; when the machines become large the reverse is the case; for large bipolar machines the voltage will limit the number of sections, and the ring armature is, therefore, preferable, because it gives twice the number of sections. For four-pole machines he finds that, as far as sparking is concerned, the drum winding with poles in parallel is equal to one with the windings in series; in ring armatures, both for parallel and series connections, the tendency to sparking will be twice as great as for drum windings; he illustrates the results by calculating actual figures for some existing machines.

Dimensions of Armature Teeth.—In an article by Mr. Baumgardt, in the "Elek. Zeit.," Sept. 1, he calculates the heat generated per unit of volume of the teeth of an armature due to hysteresis; applying his formula to special cases and plotting the results as curves, he finds that the heat per unit of volume of the teeth at first diminishes slightly as the width of the space for the wire increases, and that it arrives at a minimum point, after which it increases very rapidly; in a ½-h. p. motor the minimum value at 3 millimetres width of space he finds to be almost ten times as small as for 10 millimetres; for a 2-h. p. motor the minimum value at 2.25 millimetres was one-sixth of that at 10 millimetres; for a 40-kw. dynamo the minimum value at 1.5 millimetres was one-eighth of that at 10 millimetres; and, finally, in a 22-kw. dynamo the minimum value was one-fourteenth of that at 5 millimetres. The minimum value cannot be reached in practice, as other conflicting conditions must also be taken into consideration. (The conclusions agree to a certain extent with those of several other dynamo builders, who found that it was preferable to make the space for the wire very deep and narrow, rather than shallow and wide.)

Armature Proportions.—In the Lond. "Elec. Eng.," Sept. 1, Mr. Weymouth discusses this subject by comparing all the properties of two machines, in one of which the length of the armature is equal to the diameter, and in the other to four times the diameter, the effective longitudinal sectional area being the same; he shows that in many respects the advantages and disadvantages balance each other; no general conclusions of any importance are drawn.

Improvements in Continuous Current Dynamos.—Mr. Guilbert, in "La Lum. Elec.," Aug. 19, discusses some recent improvements in dynamos, giving the data of some French machines, which embody some of these improvements; the improvements themselves are not altogether new; the chief one is the neutralizing of the armature reaction, which is done by cutting the polar faces in two at their middle point, thereby introducing an air gap which resists only the lines generated by the armature reaction; also by winding additional coils around the pole pieces parallel to the armature coils (as suggested by Prof. Ryan); the arrangement for multipolar machines is ingenious and interesting.

Lead of the Brushes.—Mr. Staner, in "L'Elec.," Aug. 19, discusses, from a theoretical standpoint, the angular lead of the brushes, and finds from his formulas that the angle of lead is approximately proportional to the square root of the current. (As so many conditions enter in the proper placing of the brushes, it is not likely that his conclusions will be of any great value.)

Variable Speed Motors.—In an interesting article by Mr. Bauch in the "Elek. Zeit.," Sept. 1, he discusses the subject of motors, which are to be run at a number of different speeds, as, for instance, for driving workshop tools or railway cars. He shows that by using a double winding on the armature, each being independent and having its own commutator, the windings being different in the number of turns; by various external connections between these two windings, and with the field and the circuit, he obtains eight different speeds, the maximum being 12 times the minimum, the efficiency remaining nearly the same in all. Although more expensive than the well known Sprague arrangement for railway motors, he claims that it has the advantage over the latter in that the maximum power is the same for all of these speeds, while in the Sprague arrangement the maximum power is obtainable only at the greatest speed.

Unipolar Machines.—In the "Elek." Zeit.," Aug. 11, Mr. Marchar, in a long article, accompanied by 25 cuts, describes the results of numerous experiments made with different forms of supposed unipolar dynamos, in all of which the result was a failure to generate any currents; the results of most of his experiments could have been predicted from the well known laws governing unipolar machines; as practical proofs of these laws, however, the paper is of interest.

Patin Fly Wheel Alternator.—The Lond. "Elec. Eng.," Sept. 1, gives the first part of a well illustrated description of this alternator, which is of the Ferranti type, and is connected direct to a horizontal engine; it is built in France; the field magnets, of which there are a great number, revolve, while the armature is fixed.

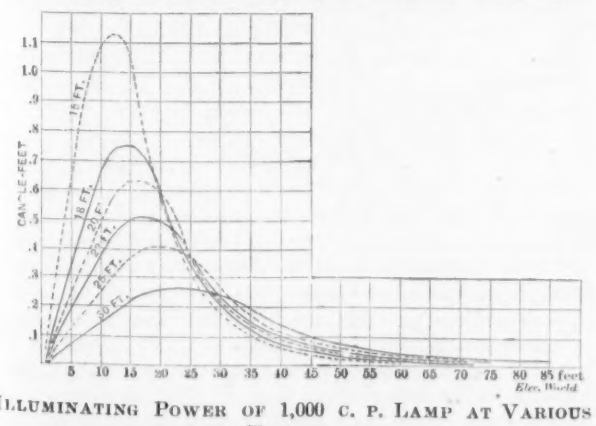
Dynamo for Testing Purposes.—"Ind. & Iron," Aug. 11, describes and illustrates a machine intended more especially for testing meters, but capable of being used also for other purposes.

Westinghouse Dynamos.—The Lond. "Elec. Eng.," Aug. 18 and 25, contains a profusely illustrated article on Westinghouse dynamos and armatures, including cuts showing the Tesla motor and its construction and method of winding of the armatures.

ARC AND INCANDESCENT LIGHTS.

Placing of Arc Lamps.—Mr. Llewellyn Preece, in the Lond. "Elec.," Sept. 1, gives some practical information, apparently based on careful consideration, regarding the placing of arc lamps in the various parts of the Midland Railway. His conclusions are briefly as follows: For platforms in freight sheds the limiting distance between arc lights is 70 feet, the standard of illumination being that a man anywhere shall be able to read with ease an ordinary label; for cranes, which are usually from 40 to 60 feet apart, the best position is between each two cranes and over the centre of the platform; over cartways the lamps are placed 100 feet apart, except where unloading is carried on direct, when 80 feet should be the limit; when two or more rows are required the average distance apart may be taken at about 80 feet; the heights of the lamps above the platforms is in all cases 14 feet, and over roads and cartways 18 feet; for yards the distance is about 100 feet and the height 20 feet, gaps greater than 250 feet being inadvisable; on approaching roads the lamps should usually be from 120 to 150 feet apart and at a height of 25 feet; for passenger station platforms the distance is 80 feet and the height 14 feet. In all the above a 500-watt lamp of nominally 2,000 c. p. is assumed, with opalescent globes for freight and passenger stations, and with clear globes in yards and approaching roads.

He also gives the accompanying diagram for general



ILLUMINATING POWER OF 1,000 C. P. LAMP AT VARIOUS HEIGHTS.

use in placing arc lamps; it gives the illuminating power of a 1,000-c. p. lamp at various heights; it is based on a recent paper by Mr. Trotter, in which he states that the illumination of an arc lamp varies as the fourth power of the cosine of the angle of incidence for angles greater than 45 degrees, and that the maximum is about at this angle; from this table the distribution of arc lamps may be determined for any given maximum and minimum illumination.

Relative Costs of Arc and Incandescent Lighting.—Mr. Bainville, in "L'Elec.," Aug. 12, analyses the cost of arc and incandescent lighting with a view to showing at what candle powers one is more economical than the other. He first analyses the cost of the arc light for various candle powers between 100 and 1,000; among other factors he finds that the cost of the material consumed, including amortization, repairs, breaking of globes, etc., amounts to 2.6 cents per lamp per day, and that the attendance amounts to about two cents per hour per lamp for installations, such as in a factory, in which the lighting is only an accessory, and one cent per hour in the case of central stations devoted entirely to lighting. In his conclusions he gives a table showing the total cost of lighting with incandescent lamps, with arc lamps at 110 volts and arc lamps at 70 volts, for candle powers from 100 to 1,000, and for four costs of a klw.-hour; this table shows very clearly at what point one becomes cheaper than the other; in general it appears that when the cost of a klw.-hour is one cent (as in water power stations, for instance) the incandescent lamp is cheaper up to about 1,000 candles; for a cost of six cents it is cheaper up to about 400 candles; for 12 cents it is cheaper up to about 200 to 300 c. p.; while for 24 cents the incandescent lamp is cheapest only for small candle power up to about 100. This has reference only to the actual cost, but in practice other indirect advantages of the incandescent lamp must also be considered. In general, the table seems to show that the incandescent lamp is relatively cheaper in many more cases than is generally supposed. A translation of the article is published in the Lond. "Elec. Rev.," Sept. 1.

Incandescent Lamp Manufacture.—The interesting serial of Mr. Ram is continued in the Lond. "Elec.," Aug. 4, 11, 18, 25, and Sept. 1, in which the subjects of mounting, flashing, resistance and size of filaments, their measurement, and glass blowing are discussed respectively. In measuring the diameter of filaments by means of a micrometer, he suggests moving the filament backward and forward between the jaws, which are steadily and slowly being screwed up with the other hand; as soon as the filament is gripped the turning of the screw must cease; in this way filaments are measured accurately without danger of breakage; he also describes a method of measuring by projecting a magnified image upon a screen; this may be modified by reflecting at the same time the image of a transparent scale held next to the filament. Besides a number of cuts and diagrams, valuable practical data and advice are given; this serial is doubtless the best of its kind ever published, showing not only long experience, but also very careful and intelligent work in this field.

Lighthouse Illumination.—The Lond. "Elec.," Sept. 1, discusses recent papers on this subject (see Digest of last week), and among other things states that it fails to see any difficulty in the designing of alternators for lighthouses, claiming that none of the leading makers of alternators would have any difficulty in building machines to suit the work (it will be remembered that Mr. Blondel, in his paper, claims that the old De Meritens machine is the only one suitable), and that those who desire to do so will probably find in that paper sufficient information to guide them.

Illumination Effects.—"La Lum. Elec.," Aug. 5, describes an exceptionally fine effect produced by colored electric lights and fountains during the recent fete day illuminations in Paris on the 14th of July.

Arc Lamps.—"La Lum. Elec." continues its series of articles on arc lamps by Mr. Richard; the articles are well illustrated, and appear to be taken from patent specifications.

The "Elek. Zeit.," Aug. 18, gives a full and well illustrated description of the new Koerting and Mathiesen lamp.

ELECTRIC RAILWAYS.

Underground Electric Railway in Brussels.—"L'Elec.," Aug. 26, contains an illustrated description, together with detailed estimates of costs, earnings, etc., of the proposed road in Brussels, already mentioned in The Electrical World, Sept. 2, page 183. The article includes a map and a profile of the road, and a plan and elevation of a station. The following figures may be of interest; 2,000 h. p. will be used for traction, 300 for elevators and 100 for lighting; there will be a reserve power of about 50 per cent. of the maximum; there will be two tunnels, one for each direction; during eighteen hours of the day there will be a train in each direction every 2½ minutes; the length of each of the two tunnels is 6,140 metres; it is estimated to take two years to finish it; the system of tunneling to be used is the Greathead system, the same as was used in the City & South London line; the surface of the ground is quite irregular, but the grades of the road will be as nearly horizontal as possible. The estimates, which are given in detail, are about as follows: For the tunnel and roadway, 13,000,430 francs; for the equipment of 16 trains, each for 60 passengers, 3,400,000 francs; the annual expenses are estimated at 1,600,000 francs, including five per cent. on the amortization of the total capital outlay. From this and the number of trips per year, it is shown that to meet the expenses the receipts of each trip must be 5.24 francs (slightly over $1); this takes but 24 passengers per trip, from which it is concluded that there is no doubt that the road will pay. An interior perspective view of the tunnel with the train is published in "Lightning," Aug. 31; from this it appears that the construction differs from the City & South London road in that there is considerable space between the walls of the tunnel and the train, more like in railroad tunnels; according to the illustration the tunnel is to be very well lighted throughout with incandescent lamps on the ceiling. The illustration is taken from "Sciences et Commerce."

Underground Electric Railway in London.—Another railway is proposed in the City of London to extend from Hampstead to Charing Cross; the bill has passed the House of Lords' Committee unopposed.

High Speed Railways.—In a brief article on this subject the Lond. "Elec.," Sept. 1, calls attention to the fact that among other things the radius of curves increases with the square of the maximum speed; also that a limit will be reached in a rise of the outer rail; that the amplitude of the transition curve will increase enormously as the speed is increased; it also calls attention to the transition gradients, with which similar difficulties will be met; from all this it concludes that to increase the speed materially it will be necessary to start out with an entirely different system of permanent ways and to redesign every detail of the track; for speeds of about 80 miles an hour, machinery of the rotary type must be used; the power required will increase with the cube of the speed; to run a train at 100 miles an hour would cost nearly five times as much as to run it at 60.

Electric Railways.—"La Lum. Elec.," Aug. 12, continues its series of articles by Mr. Richard, illustrating appliances and systems. These articles are profusely illustrated with very good cuts, and although presumably taken from patent specifications, they frequently contain matters of interest.

Lauterbrunnen-Murren Railway.—"La Lum. Elec.," Aug. 19, describes briefly this interesting Swiss road; a cut showing the profile is given; it will be remembered that the first portion of this mountain electric road is a steep inclined plane operated by a cable, with a car at each end, nearly balancing each other; it is operated by water power.

Railway at Salève.—"Ind. & Iron.," Aug. 11, gives a brief description, accompanied by three cuts, of this mountain road, in which rack and pinion traction is used; " it is of interest as being the first Continental railway to be run entirely by electric power" (probably as distinguished from city "tramways"); water power is used in the generator station; the current is supported from an ordinary rail, with the lower side up, parallel to the tracks, and carried on porcelain insulators; when worn the contact of the track rails can be interchanged.

Railway at Remscheid.—The "Elek. Zeit.," Sept. 1, describes briefly this new German railway, one of the interesting features of which is that less than one per cent. of it is on a level; the Thomson-Houston system is to be used.

Variable Speed Motors.—See paragraph under Dynamos and Motors.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Possible and Impossible Economies in the Utilization of Energy.—The Lond. "Elec.," Aug. 4, 11 and 18, reprints an interesting Roy. Institution paper of April 21 on this subject by Prof. Kennedy. Most of it is devoted to the subject of gas and steam engines and boilers; he shows very clearly what efficiencies have been reached in each transformation, and also what the theoretical maximum possible efficiency is in each case, beyond which it is, of course, impossible to go; he shows clearly how these maximum efficiencies differ from the apparent total efficiencies. The article is very well written throughout, and is well worth the attention of those interested in this subject; it contains nothing new, however, with the exception, possibly, of the ingenious method of representing the efficiencies and losses by means of diagrams. Among his conclusions are that the steam engine has nearly reached its maximum possible efficiency; that there is much more room for improvement in the gas engine, which has a much higher possible efficiency than the steam engine, and that the worst efficiency of all is the final transformation of energy into light in the incandescent lamp. Diagram Fig. 9 on page 415 of that journal is particularly interesting.

Most Economical Location of a Central Station.—Mr. Jehl, in the "Elek. Zeit.," Aug. 25, discusses the subject of the best theoretical location of a centre of distribution to supply given currents at given points; the results are more of interest than they are of practical value, although some of his conclusions may be of use in practice; the following simple system, for instance, might sometimes be of use: Locate the points to which current is to be supplied on a drawing board, place a pulley at each of these points, over each of which run a cord having a weight attached proportional to the current; tie all the other ends together, and allow the system to come to rest, the weights hanging vertically; the position of the common junction of the strings will then be the location of the centre of distribution for the greatest economy in copper.

Cassel.—The "Elek. Zeit.," Aug. 4, contains a detailed description, accompanied by 10 illustrations, of the central station in the city of Cassel; the station is of special interest for several reasons; the power is taken from a waterfall 3.6 miles from the city; four turbines of 50 h. p. drive a common shaft, from which two alterna-

tors of 100 h. p. each are driven by belts; these are run in parallel at 2,200 volts; the current is transmitted to two stations in the city, in each of which the high tension alternating current is transformed into a continuous current by means of motor dynamos, and in one of these the current charges accumulators from which it is distributed on the usual three-wire system; the parallel connection of the alternators is said to offer no difficulties whatsoever (even though they are driven from a common shaft by belts); the exciting current for the large alternate current motors at the stations in the city is obtained from the accumulators; the motor is coupled to the two continuous current dynamos by means of a rubber coupling, which, besides being elastic, insulates the latter from the high tension circuit; the synchronous alternate current motor, which is identical with the generator, is started with a current from the accumulators, which drives the continuous current dynamo as a motor, which in turn brings the alternate current motor up to synchronism; the usual lamp indicator is used to show when the two are in phase; in the second station, where there are no accumulators, the starting current is taken from the mains, which are connected to the other station. The article concludes with a table of the operating expenses in detail.

Chur (Coire) —The "Elek. Zeit.," Aug. 4, publishes a rather full description of this Swiss station, including several illustrations. The 400 h. p. is obtained from a very high waterfall 1.5 miles from the city; the generating station contains five alternators of 100 h. p. each, which are run in parallel at 2,000 volts; the coupling in parallel is accomplished without the use of dead resistance, and offers no trouble whatsoever; to show the ease with which they are run in parallel, three dynamos were run together with a total current of only 5 amperes; the leads to the city consist of two pairs of wires, one for lighting and one for motor service; the lines are run on oil insulators; in order to reduce the cost of installation, small transformers in large numbers were used in the lighting circuit; arc lamps are run from separate transformers which transform directly from 2,000 down to 30 volts, thus making each lamp quite independent; numerous non-synchronous motors, from 1 to 9 h. p., are in use and are connected with the lighting circuit; they have neither commutators, collectors nor brushes, and occupy a very small space; they are meeting with great favor; there is a large synchronous motor of 100 h. p., which is started by means of a 9 h. p. non-synchronous motor.

Cambridge.—The Lond. "Elec. Rev.," Sept. 1, gives an illustrated description of this somewhat novel station; as will be remembered, Parsons' compound steam turbines are used, connected directly to 2,000-volt alternators; there are at present three such units of 150 kw. each; they are entirely independent of each other and the alternators are not coupled in parallel; the expansion is 150 fold and the speed 4,800 revolutions; the current is 75 amperes and the frequency 80; an automatic variable valve gear and governor enables the full range of expansion to be maintained at light loads, thus allowing considerable economy of fuel on the all day load; according to Prof. Kennedy's test the steam consumption is at the rate of 19.5 pounds of water per electrical h. p. at full load. The illustrations include an interior view, an external view of one of the units and three views of the switchboard; the ultimate capacity will be equal to 30,000 lamps of 10 c. p.

Three-Phase Installation at Bockenheim.—"La Lum. Elec.," Aug. 5, 12 and 19, contains a long, well illustrated article descriptive of this plant. An abstract of another and less complete description was contained in the Digest, Sept. 16.

Monte-Carlo.—"L'Elec.," July 29, gives a brief description, with two cuts, of the installation at the Hotel Metropole; Willans compound engines coupled direct with Siemens compound dynamos are used; notwithstanding the high prices of coal ($10 per ton), the cost of a kilowatt-hour is only 14.6 cents.

Thomson's Lightning Arrester.—Mr. Zielinski, who recently made very complete tests of lightning arresters for telegraph purposes (see Digest, July 1), subsequently also tested the double coil arrangement of Prof. Elihu Thomson, described in The Electrical World, Feb. 20, 1892, and gives the results in the "Elek. Zeit.," Aug. 25. The conclusions to which he comes, from figures representing the efficiency of a lightning arrester, are: That the efficiency of the Thomson double coils is not affected in any way by the ratio of the number of windings in the two coils (this appears contrary to what Prof. Thomson found), but that it is affected by the volume of the discharge, as also by the self-induction of the apparatus to be protected; that a dynamo would be protected just as well without these coils as with them; that the self-induction of an apparatus is as advantageous for the efficiency of a lightning arrester as it is disadvantageous in the circuit of the arrester itself; that the coils when used in connection with apparatus having no self-induction not only do not protect it from atmospheric discharges, but can, moreover, be injurious. (Perhaps this will require further proof before it can be accepted.)

Driving Gear for Dynamos and Alternators —"Ind. and Iron," Aug. 11, describes and illustrates a driving gear specially adapted for alternators in parallel, as it holds them rigidly in complete synchronism.

WIRES, WIRING AND CONDUITS.

Insulation Resistance of Porcelain Insulators After Use —An article in the "Elek. Zeit.," Sept. 1, by Messrs. Strecker and Karrass, gives the results of extended tests of used and unused insulators of the German government lines, both before and after a rain. It appears that there is little difference between those which have been used on country streets, on railroads, near the sea, near factories or chemical works; they find that in either used or unused the resistance is slightly lower after a heavy rain, and that it recovers itself more quickly the cleaner the insulators are kept; it suggests that the insulators be cleaned once a year or oftener.

House Wiring.—The novel and ingenious system of interior wiring invented by Mr. Peschel, introduced in Germany by the firm of Hartmann & Braun, and described in the Digest June 17, is described and illustrated in "Ind. and Iron," Sept. 1; the wires are carried by porcelain beads secured on the surface of the wall, and are visible throughout, the fixtures being such that the wiring may be quite decorative.

Calculating Leads.—The "Elek. Zeit.," Aug. 25, illustrates and describes in a brief note an apparatus for determining the cross-section, loss of voltage, or current strength, in a network of wires, by means of a mechanical arrangement, consisting of weights, strings and balances; (the apparatus itself is exhibited in the German section at the World's Fair).

Measuring the Diameters of Wires.—In the "Phil. Mag." for August, Profs. Dewar and Fleming describe the use of the microscope for measuring the diameters of wires by optical projection.

Leads for Parallel Working.—Mr. Snell, in his serial in the Lond. "Elec.," Sept. 1, discusses this subject.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Field Telephony.—In the "Elek. Zeit.," Aug. 25 and Sept. 1, Mr. Weitz describes at some length, with the aid of 18 cuts, the Gattinger telephone system, the object of which is to establish telephonic communication over any convenient telegraph line without interfering with its use for telegraphing, and without being influenced by the simultaneous use of the line for telegraphing. It has been used on Austrian lines for some time past and has been so satisfactory that its introduction is now being increased; the arrangement is somewhat complicated, and does not admit of being abstracted here, except to say that it is based on the use of condensers; it is in use on railroad lines; in one case very good communication was had over a distance of about 38 miles of a telegraph line using Morse signals, and including in its circuit a station which was not bridged over.

Long Distance Telephony.—According to "La Lum. Elec.," Aug. 5, a long-distance line will soon be constructed between Malmoe and Haparanda, in Sweden, which is said to be longer than the New York and Chicago line.

Telegraphy and Telephony in Japan.—From the official reports it appears that at present there are 8,543 miles of telegraphic lines in Japan, consisting of 24,314 miles of wire; there are 214 miles of submarine cables, 375 telephonic lines of 3,234 miles of wire. It is interesting to notice the comparatively large proportion of telephone to telegraph lines.

The Azores Cable.—The Lond. "Elec.," Sept. 1, gives a brief description of the inauguration of this cable, which took place on the 27th of last month; it was laid by an English company and is 1,212 knots long.

Controller.—"L'Elec.," Aug. 5, describes at some length the controller of Mr. Poulpiquet, in which a record is produced at one central point of the presence of the watchman at each of the various boxes.

Interlocking Railway Systems.—"L'Elec.," Aug. 26, describes briefly the Huton system.

ELECTRO-CHEMISTRY.

Plating Aluminium.—Before plating aluminium it is usually first covered with a coating of zinc; according to "La Lum. Elec.," Aug. 19, Mr. Wegner makes this intermediate step unnecessary by treating the aluminium in a bath of acetate of copper, oxide of iron, sulphur (in what form?) and chloride of ammonium, after which it is rubbed lightly with a brass scratch brush; it can then be plated directly; this treatment not only cuts the apparently greasy surface of the aluminium, but appears to fill up the pores.

Neuhausen Aluminium Factory.—According to "La Lum. Elec.," Aug. 12, four more dynamos have recently been installed, making a total of 3,900 h. p.; the dynamo shafts are vertical, and are coupled direct to the turbine; the dynamos carry the full load day and night for several weeks at a time.

Rhodium and Tungsten Plating.—"La Lum. Elec.," Aug. 12, gives the following bath for rhodium plating: Water, 1 litre; rhodium sulphate, 100 grams; fluor-silicate of ammonium, 100 grams; sal-ammoniac, 100 grams; cyanide of ammonium, 50 grams; copper or oxidized iron plates better than pure iron; as is well known this metal is extremely hard and refractory, and is not attacked by the usual reagents. The operation is like that of platinum plating. The "Rev. de Chimie Ind." gives the following receipt for a tungsten bath: Water, 1 litre; nitrate of tungsten, 100 grams; phosphate of potash, 100 grams; acetate of ammonia, 150 grams. Tungsten has the color of iron, is very hard, and is attacked by nitric acid, but not by air, sulphuric acid or hydrochloric acid.

Barium Accumulator.—According to "La Lum. Elec.," Aug. 12, the Lehmann accumulator, made of peroxide of barium pressed into lead plates, in a solution of chloride of barium, may be charged more rapidly than the usual accumulators, that it gives a greater discharging current and a higher voltage; it is claimed that there is no polarization, and the positive plate is said to absorb oxygen from the air which continually regenerates the plate.

Bleaching.—The "Elek. Zeit.," Aug. 25, mentions briefly a recent patent granted in Germany for bleaching textile fabrics; it appears that the fabrics are hung in chambers into which ozone is introduced; the time of bleaching is reduced one-third, and the fabric is improved in quality.

MISCELLANEOUS.

Work for Technical Colleges Students.—"Ind. and Iron," Aug. 11, suggests editorially that instead of spending so much time on scientific researches which have comparatively little value, it would be well if students would undertake more practical subjects, among which the following are suggested: The testing of iron—that is, information as to what kind of iron or steel is best, so that iron makers may be able to make the proper qualities to order; the power to keep a mass of metal at a given high temperature, in order to give data for designing plants for electrical heating of masses of metal; the carrying capacities and resistances of hot wires for use as rheostats for large powers; the carrying capacities of spirals of different pitch and diameters and sizes of wire, for copper and various alloys; the carrying capacity of wires under water; an alloy of high conductivity and low temperature coefficient for use in meters and voltmeters.

High Frequency Currents.—Dr. Oudin, in "L'Elec.," Aug. 5, describes the different effects of various arrangements and modifications of the apparatus used by Dr. d'Arsonval for producing high frequency currents, intended for medical purposes; the fundamental apparatus consists of an induction coil with knob dischargers connected to two Leyden jars, the external coatings of which are connected together through a coarse spiral of thick wire, from the terminals of which high frequency discharges are obtained; the modifications consist in general of the insertion of coils in the wires leading off from this spiral; among other things he shows how very necessary it is to make very careful adjustments in order to get the desired results.

The Harmlessness of High Frequency Currents.—The Lond. "Elec. Rev.," Sept. 1, reprints a note by Dr. Hedley from the "Lancet"; he briefly reviews the subject again, as has been done before, and concludes that the harmlessness is mainly due to the small current strength; also that the sensation and muscular contraction are influenced by the frequency, the shape of the wave and the concentration of the current on the area of contact.

Submarine Boat.—"La Lum. Elec.," Aug. 19, states that the Gustave-Zede was recently launched at Toulon; its displacement is 226 tons, and it can develop 720 h. p.; it is, therefore, larger than its predecessors, the Gymnote and the Goubet; the power is furnished by electrical accumulators, which have the important advantage in that the weight of the boat is not altered by the consumption of the power, which it would be if coal, compressed air, etc., were used.

Night Life Preservers.—The "Elek. Zeit.," Sept. 1, reports a successful experiment made with a life preserver, sufficient for supporting four people, and containing Pollak accumulators and a bright incandescent lamp, readily visible at 3,000 feet; it is intended to be thrown on the water at night in case some one has fallen overboard; the lamp is lighted as soon as the apparatus touches the water.

Artificial Diamonds.—In a note by Mr. Rousseau in "Comptes Rendus," July, reprinted in "La Lum. Elec.," Aug. 12, he describes some experiments showing that a very dense carbon resembling the diamond can be obtained in the electrical furnace from acetylene under atmospheric pressure, although greater pressures give the same results at lower temperatures.

Sterilizing Milk.—The Lond "Elec. Rev.," Aug. 18, states that a process has been invented in Holland in which milk is sterilized by subjecting it to the action of a strong alternating current; it is claimed that all microbes present, whether derived from the air, the vessels or diseased cows, are thereby destroyed and that the risk of transmitting infectious maladies is obviated.

Marble Making.—The Lond. "Elec. Rev.," Aug. 18, mentions briefly that Mr. Chatelier recently succeeded in producing marble from pure calcine carbonate by the combined action of a very great pressure and the heat of an electrically heated platinum wire; the results are interesting, but do not appear to possess any practical value.

Invention of the Lightning Rod.—According to "Ind. and Iron," Sept. 1, Mr. Brugsch, a German Egyptologist, claims that he has abundant testimony that the Egyptians used a form of this instrument for protecting their temples against atmospheric changes.

Mechanical Application of Electricity.—"La Lum. Elec." continues to publish the series of articles on this subject by Mr. Richard. The articles are profusely illustrated, and although presumably taken from patent specifications, they contain matters of interest.

Programme of the Milwaukee Meeting of the American Street Railway Association.

The twelfth regular (annual) meeting of the American Street Railway Association will be held in the hall of the Exposition Building, Milwaukee, Wis., the third Wednesday in October (the 18th), 1893, commencing at 10 o'clock a. m., and continuing three days. The following is a general programme of the meeting:

Reports of Special Committees.—Special committees will report on the following subjects: "Best Method of Lighting and Heating Street Railway Cars," "Can the T-rail Be Satisfactorily Used in Paved Streets," "Direct-Driven Generators," "Power-House Engines," "Standard Form for Street Railway Accounts," "Standards for Electric Street Railways," and "Storage Batteries in Connection with Central Stations for Utilizing Surplus Energy for Lighting or Power." Notice has been received by the secretary that a special paper will be read on the following subject: "Some Practical Points in the Construction of Underground Feeders."

Exposition of Street-Railway Supplies.—The Executive Committee has secured the Milwaukee Industrial Exposition Building for the exhibition of supplies and manufactures of every nature used in the street railway business. It has been engaged for two entire weeks, beginning Oct. 9, and ending Oct. 23, thereby giving ample time for the setting up and removal of the largest and heaviest exhibits. A comprehensive idea of the size of the building will be obtained from a glance at the lithographic sketch at the top of this page and a perusal of the dimensions stated thereunder. The hall for the meeting is also in the same building on the second floor, and delegates will therefore be enabled to examine the exhibits with much greater satisfaction than heretofore. The exposition will be in charge of the secretary, assisted by Mr. A. Trumpff, secretary of the Milwaukee Industrial Exposition Association.

Reduced Rates of Fare.—In consequence of the World's Fair being at Chicago, most of the traffic associations will make no other concessions than their so-called World's Fair rates for all meetings held at Chicago or places in its vicinity. The Western Passenger Association, in whose territory Milwaukee is located, has granted the courtesy of a fare and one-third for the round trip to all, including friends and members of families of all in attendance at the convention, whether delegates, supplymen or others. This reduced rate becomes effective only when evidence is presented to the joint agent of the terminal lines at Milwaukee, showing that 250 persons have actually been in attendance holding certificates.

Miscellaneous.—The annual banquet will take place on Thursday evening, Oct. 19. As to local entertainment, the Milwaukee Street Railway Company proposes to extend every courtesy to those who attend the meeting. The presence of a large number of ladies is anticipated, and arrangements will be made for their participation in all the events. The hotel accommodations are said to be ample. The headquarters of the association will be at the Plankinton. It is requested that those who expect to attend the meeting will communicate with Mr. F. H. Whitney, in care of the Milwaukee Street Railway Association, in order that accommodations may be secured.

Underwriters' International Electric Association.

A meeting of the sub-committee appointed at the meeting of the electrical committee of the Underwriters' International Electric Association recently held in Chicago was held at the rooms of the New England Insurance Exchange, Boston, Mass., on Sept. 5, 6 and 7, to consider certain matters referred to them by the Chicago meeting, and also to define the word "approved" as used in the present underwriters' rules.

The committee consisted of F. E. Cabot, superintendent of the Survey and Electrical Department of the Boston Board of Fire Underwriters; Geo. P. Low, electrician of the Pacific Insurance Union; E. A. Fitzgerald, electrical inspector of the Underwriters' Association of New York State; Wm. H. Merrill, Jr., electrician of the Chicago Fire Underwriters' Association, and A. E. Van Geisen, electrical inspector of the New York Board of Fire Underwriters. All the above gentlemen were present, as were also Mr. Geo. W. Wilson, electrical inspector of the Boston Board of Fire Underwriters; J. Couilliard, electrical inspector, and C. M. Goddard, secretary and electrician, of the New England Insurance Exchange.

The principal work of the committee was considering what forms of insulation for wires and materials for fittings would be approved by the association, the drawing up of rules for the introduction of automatic fire alarm systems, and considering a few amendments to the rules which were referred to them by the meeting at Chicago.

All their recommendations on these points will be submitted to the remaining members of the electrical committee for approval, after which the work of the committee will be put in shape and forwarded to the underwriters' organizations in the United States, and given to the press for publication if they desire it. By invitation, the committee visited the laboratory of the American Bell Telephone Company, and examined devices for protection of telephone and other wires against abnormal current. By courtesy of Mr. A. E. Bliss, general manager of the Malden Electric Light Company, the committee visited the station at Malden, Mass., and were allowed the use of their 500-volt dynamo for testing various forms of cut-outs for high potential circuits. The experiences of the various members of the committee, together with the fact that the amendments to the rules now in force are very few, are convincing proofs that the work of the committee and the association thus far has been extremely successful, and that the rules recommended by them have been found satisfactory, both to the insurance and electrical interests.

New York State Street Railway Association.

The Street Railway Association of the State of New York has issued a pamphlet containing the report of its tenth annual meeting, list of officers, constitution and by-laws.

A Modern Manufacturing Establishment.

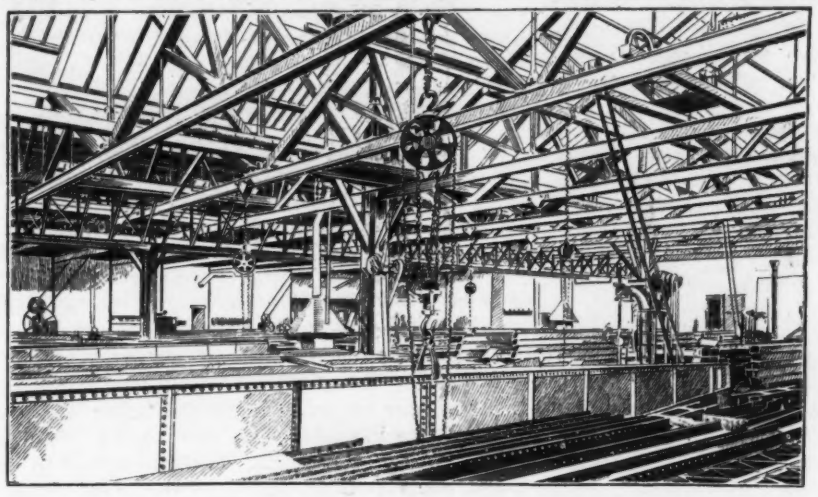
The Wrought Iron Bridge Company, of Canton, O., which was incorporated in 1871, has for some years, been working under a disadvantage on account of cramped quarters and buildings not adapted to modern methods. Realizing the great benefits of a large, well appointed and thoroughly equipped plant, the company, in 1891, secured a site 12 acres in extent for the purpose of building a new factory, and work was immediately commenced. The accompanying illustrations give some idea of the completeness with which this idea has been carried out.

The new works are situated in the southwestern part of the city of Canton, O., on the line of the Coshocton & Zanesville branch of the C., C. & S. R. R., and are accessible by independent switch tracks to the Valley branch of the B. & O. R. R., and to the Pennsylvania Railroad. Electric street railway cars run to within seven minutes' walk of the office, and within a few months they will pass by the company's ground.

The main building covers a space 256 feet square, with the gable ends facing east and west, and is so constructed that it may be extended several hundred feet on the west end, without changing in any way the part already built, or interfering with the present arrangement of the machinery. The first 31 feet in depth from the north side is divided into the smaller departments: Superintendent's office, 32 feet; template and pattern room, 80 feet; tool room, 32 feet; machine shop for small tools, 80 feet; packing room, 32 feet; of the remainder, all but 187½ by 64 feet on the east end is used as the main shop for the manufacture of built-up members; 150 by 64 feet on the east end is used for the forge shop, and is connected by the narrow gauge tracks, with the yards, stock house and main shop. The main shop is so constructed as to have but four columns in the entire area. Each line of trusses, every 16 feet apart, is built with the lower member adapted for the use of a trolley, giving every trolley, except on the column lines, a travel across the entire shop, or 225 feet.

A distinctive feature of the plant is the transmission of power by electricity, and this is the first bridge company to adopt this method of transmission in its entirety. The use of electricity does away with the necessity of having overhead shafting. The advantages of this method of power transmission for bridge construction are readily seen, as it permits the free use of trollys and traveling cranes over the entire floor space of the building; furthermore, shafting secured to roof trusses, which are used for lifting materials, is continually getting out of line, and causing much trouble on account of the deflection of the trusses. There being but one short counter shaft between the motor and the machine driven by it, the machine may be easily made to face in any direction desired, without the complications which would arise from the use of long lines of shafting.

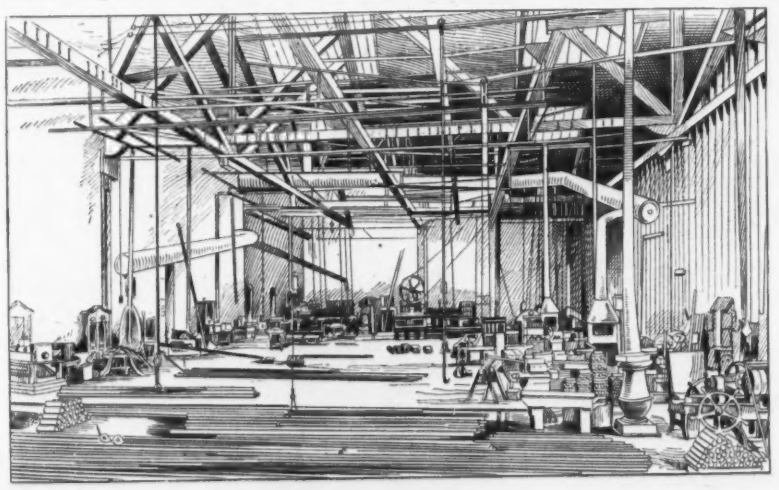
Another purpose to which electricity is put is its use in the heating system for the large office building located at some distance from the shops. A fan in the basement, driven by a motor, forces the air through a heating furnace and then distributes it through the building.



INTERIOR VIEW LOOKING NORTHEAST.

INTERIOR VIEW LOOKING EAST.

THE PLANT OF THE WROUGHT IRON BRIDGE COMPANY.



THE SMITH SHOP.

THE DRAFTING DEPARTMENT.

THE PLANT OF THE WROUGHT IRON BRIDGE COMPANY.

The works are lighted throughout by electricity, both incandescent and arc lights being employed. In the engine room, 37½ by 64 feet, just north of the forge department, are located the engines, electric generator, incandescent and arc light dynamos, air compressor and receivers, and overhead are the pressure and heating fans. From the electric generator the power is conveyed to motors, placed in various parts of the shop, each motor operating one or more machines, as circumstances require.

The boiler room, outside of the main building and next to the engine room, is fitted with a boiler and furnace of the most approved type, the feed water before passing to the boiler being purified. The exhaust steam, besides heating the feed water, is used during cold weather for the heating of the works, by passing it through coils of pipe in a heater box through which air is forced by a fan for distribution throughout the building.

The main switch track enters the grounds at the northeast corner; from it switch off other tracks to properly distribute the material as it arrives and store it on skids specially adapted for the purpose, or convey it to the stock house if it is to be on hand for a considerable time prior to use. The stock house and skids are accessible by narrow gauge tracks, and by suitable cars the material is conveyed to the shops as requirements demand. The material for built up members is conveyed to the shop on the north track, unloaded at the adjacent skids in the shop, there laid off and marked for punches and shears; passing from punches and shears to straightening machines or curving rolls; thence to assemblers; from assemblers to reaming tools; reaming tools to riveters and riveting machinery; riveting machinery to planers; planers to fitters; fitters to drills; drills to storage ready for loading. The machinery for the several operations through which the material passes is arranged in consecutive lines, east and west. The material while undergoing these operations is passing by a more or less zigzag course from north to south, arriving on the south in a finished condition, ready for storage or to be loaded directly on the cars for transportation to destination. The loading switch track enters the shop on the south side at a depression four feet below the shop floor. Fourteen feet of the width of the shop, next to the track, has been specially prepared for the storage of finished work, thus permitting the operations of painting and loading to be carried on under cover independent of the condition of the weather. In order to provide additional storage, the depressed track continues out of the shop, giving a total loading line of 500 feet.

The aim throughout has been to lay the foundation for solid growth and to provide for most economical operation. The company, with the great advantages given by a modern shop and long experience, looks forward to even greater success in the future than has rewarded its efforts in the past.

An Electric Street Railway Conduit Trial.

In The Electrical World of July 1, 1893, is an illustrated description of an interesting experimental conduit electric railway at Coney Island, one of the principal features of which is that the line is entirely insulated except when delivering current to a shoe projecting into the conduit from the car.

Briefly stated, the system consists of a shoe projecting from the bottom of a car into a conduit, and a series of contact boxes connected with the line and placed at equal intervals along the sides of the interior of the conduit. Levers projecting from the boxes are moved when the shoe encounters them, which switches on the current from the line; the current then passes through the end of the lever by sliding contact on the metallic side of the shoe, and thence to the motor, whence it goes to the return line by the other side of the shoe in a similar manner. The line is completely insulated in the boxes within the boxes, except in those opposite the shoe, which are never more than three in number; as a consequence, any leakage can only occur during the brief time they are connected with the line, and this is provided for by careful insulation of the lever mechanism.

A public experiment was made on Friday, Sept. 15, to show the admirable insulation of the line under the most adverse circumstances. To this end about 100 feet of the conduit was filled with a mixture of mud and water, and the car was run back and forth, and stopped while readings of instruments were taken to determine if there was any leakage. The measurements showed that practically no part of the current was lost, and those in attendance pronounced the experiment as satisfactory and proving the claims made.

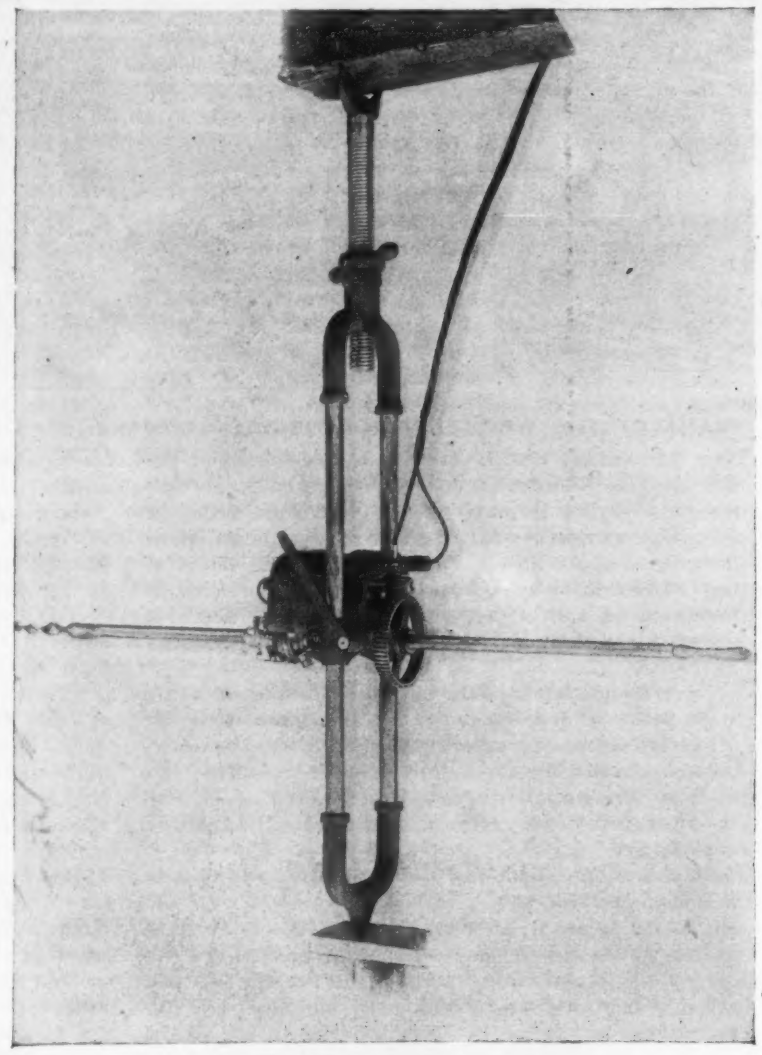
Mr. Albert Stetson, the electrical engineer of the Universal Electric Company, 150 Broadway, New York, was in charge of the experiments.

The General Electric Mining Drill.

A small portable drill for both anthracite and bituminous mines to supplant the laborious breast drill, and to be used in place of percussion hand drills in work involving the removal of the slate or rock roof and floor, long needed, has been recently put out by the General Electric Company.

Two types are made, one for heavy work in anthracite or drilling in hard slate or "boney," the other for lighter anthracite drilling and for bituminous coal. The drills are interchangeable in their mountings, the same post taking either. The control of the motor is effected by a small plug switch. Feed screws of different pitch are furnished for varying the speed of boring, and a friction clutch protects the motor should any particularly hard obstacles be struck suddenly.

The columns are made in different lengths, and each is adjustable for about two feet variation. The construction of the drill and its method of mounting enable the operator to drill close to the roof, floors or walls as well as in any direction, as above noted.



AN ELECTRIC MINING DRILL.

A series of tests with one of the drills were made at the Wm. A. colliery of the Connell Coal Company at Duryea, Pa., with the following results:

Material drilled.	Threads per inch on feed screw.	Depth of hole.	Time.
1. Hard slate....	4	2 feet	30 seconds
2. Hard slate....	4	2 feet 6 inches	32 seconds
3. Anthracite coal.. ..	4	2 feet	17 seconds
4. Anthracite coal.. ..	4	2 feet 6 inches	17 seconds
5. Hard slate....	4	2 feet 1 inch	20 seconds
6. Hard slate....	4	2 feet 6 inches	25 seconds
7. Rock ("boney").....	6	2 feet 6 inches	50 seconds
8. Rock ("boney").....	6	2 feet 6 inches	94 seconds
9. Hard slate....	4	2 feet	

Test No. 4 showed a rate of drilling of 6 feet in 48 seconds. Tests Nos. 7 and 8 were made in a very hard rock, locally called "boney." It is about the same nature as a very hard white slate.

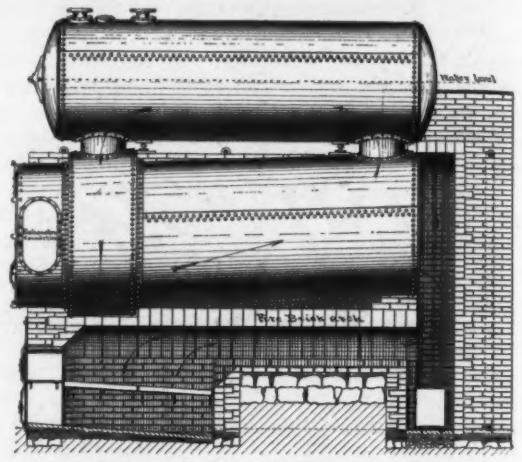
After these tests the drill was placed at work upon the floor of a portion of the mine which consisted of very hard rock which no breast auger or machine drill could be used in. Previously the holes had been drilled by two men, one holding the bar and the other driving it with a sledge, and who were able to drill a hole 3 feet deep in from 2 to 2½ hours. There was also a large amount of water in this part of the mine. Two men handled the drill; the time for drilling a 5-foot hole was 3 minutes and 20 seconds. Five holes were drilled and blasted by two men in 2½ hours, and about 500 cubic feet were loosened ready for loading on the mine cars. The next day the drill was used for boring 300 feet of roof along the main gangway, which was 8 feet 6 inches in width, the average thickness of the material blasted being 3 feet. Two men handled the drill, two tamped the holes for blasting, and eight laborers took away the material. Two men put in 60 feet of holes in 2½ hours, in addition to tamping four of the holes in the meantime. The material in the roof was very hard slate, and the holes were all drilled at an angle of from 30 to 40 degrees.

The smaller drill weighs with post complete only about 160 pounds, the drill itself weighing 100 pounds. In bituminous coal this drill shows a speed of drilling of 5 to 7 feet per minute with a six-thread screw.

It will, therefore, be seen that these rotary drills meet the requirements of strength, lightness, capacity, ease of control and adjustability, practicability and economy.

A New Boiler.

A new boiler, invented by C. C. Peck and manufactured by the Stearns Manufacturing Company, Erie, Pa., whose claims are entitled to the consideration of engineers and steam users, has for its main feature the application of the principle of water circulation of ordinary water tube boilers to shell boilers. This is simply carried out by constructing the boiler with two shells, one above the other, and connected by two necks, one at each end of the shell. These necks are of large area, and one connects the top of the lower shell with the bottom of the upper one, and the other the bottom of the upper shell with an annular water passage formed around the lower shell; this passage communicates with the lower shell by a hole of the same size as the neck cut through the bottom of the lower shell.



A NEW BOILER.

This arrangement compels the water, which about half fills the upper shell, to circulate through the annular passage, and enter the lower shell as fast as the water and steam in it rise and enter the upper one at the opposite end. Thus a strong circulation of all the boiler water in a circuit is insured, which gives a maximum value to the heating surface and delivers dry steam into the upper shell, and at the same time keeps the boiler structure at nearly uniform temperature. Most of the space in the lower shell is occupied by tubes.

The operation of the boiler is found to be satisfactory in every way, it is stated, and an important advance in boiler construction is claimed.

The S. & C. Interlocking Carbon Connector.

Since the introduction of carbon batteries for telephone service by the telephone companies much trouble and annoyance has been caused by the use of a carbon connector which does not insure a tight and rigid connection with the carbon. There being no means of securely locking the wire in place loose connections would often occur through the handling of the battery, and not be noticed until after considerable expense had been resorted to in locating the difficulty.

The E. S. Greeley & Co., 7 Dey street, New York, who were among the first to notice the fault with the old style, have produced a carbon connector called the S. & C. interlocking carbon connector, which they claim gives a perfectly rigid grip upon the carbon and connecting wire, and will not turn or work loose after once having been locked in position. It is said that the S. & C. overcomes the faults found with the old style connector.

INTERLOCKING CARBON CONNECTORS.

We present two views of the S. & C. connector, one showing it in detail and the other as it appears on the telephone standard carbon. The principal features of this device are its interlocking qualities, its large contact surface and the means of supporting the carbon on the battery cover.

It will be noticed in the detailed cut that the bolt has a square neck, and that it fits into square holes in the contact plates, thus interlocking, and prevents the bolt from turning when the nuts are screwed up.

NEW BOOKS.

BENJAMIN FRANKLIN AND THE UNIVERSITY OF PENNSYLVANIA. Edited by Francis Newton Thorpe, Ph. D., University of Pennsylvania. Washington: Bureau of Education. 1893. 450 pages; 37 illustrations.

The United States Bureau of Education has added to its valuable series of educational monographs a portly volume on Benjamin Franklin and his influence on educational methods, with particular reference to the establishment and career of the University of Pennsylvania.

The author states in the preface that he has attempted to outline the influence of Franklin on American education, which is felt to this day, by tracing the eminent philosopher's own self-education; by presenting his ideas on education as shown in his works; by comparing them with the ideas of the eminent men of his time, Adam Smith, Hume, Priestly, Washington, John Adams, Jefferson, Hamilton and some of the physiocrats; by describing the educational institutions which he founded—the Library Company of Philadelphia, the American Philosophical Society and the University of Pennsylvania—and the principal educational institutions founded in Pennsylvania in conformity with his ideas—Franklin and Marshall College, the Franklin Institute, Girard College and the Philadelphia Manual Training Schools—institutions which touch life at every point and represent every important phase of modern education.

An important chapter is that devoted to giving Franklin's ideas in education, as seen in his writings, the comparison of these with those of Adams and Jefferson, and the relative bearing which the views of these three distinguished men have had in forming the educational systems of the United States.

The major portion of the work is devoted to tracing the career of the University of Pennsylvania, and the illustrations, with a few exceptions, are of buildings, laboratories, etc., of that institution. In fact, the book consists of two separate parts, of which the much larger one is descriptive and eulogistic of the University of Pennsylvania, with little or no reference to Franklin.

ELECTRICITY UP TO DATE. for Light, Power and Traction. By John B. Verity, M. I. E. E. Third Edition. New York: Frederick Warne & Co., 1893. Paper covers, 163 pages, illustrated. Price, 75 cents.

This brightly covered pamphlet contains a summary of the principal practical applications of electricity, and several chapters of interest on English public supply companies. These are briefly described and data given as to capital, number of lamps, prices, etc.

As all the information is of a practical nature, and as no attempt is made to enter into theories, the book will be of interest to the general reader who wishes to obtain some knowledge of a general character on electrical applications.

Recent Electrical World Visitors at the World's Fair.

The following have registered at the headquarters of The Electrical World since our last bulletin, which appeared in the issue of Aug. 19:

C. N. Boorse, Philadelphia, Pa.; Edward Sullivan, New York City; Sadie Y. Foster, Chicago; A. A. Serva, Canton, O.; Geo. M. Mayer, Chicago; E. Braun, Clarendon, Ill.; F. G. Ehlert, Milwaukee, Wis.; H. W. Korhammer, Webster, Mo.; Howard J. Webster, Philadelphia, Pa.; E. M. Rogers, San Francisco, Cal.; E. M. Lerois, Marseilles; Herman F. Cuntz, Hoboken, N. J.; Harry Roebuck, E. Las Vegas, N. M.; Chas. F. Medbury, Montreal, Canada; R. E. Pimple, Montreal, Canada; A. F. Lay, Quebec, Canada; J. K. Fyfer, Columbia, Mo.; Eva I. Maims, Ann Arbor, Mich.; Louis Jay Gerson, Philadelphia, Pa.; Louis W. Emerick, Syracuse, N. Y.; Geo. A. Harker, St. Louis, Mo.; Eugene Burns, Washington, D. C.; H. C. Adams, New York City; C. A. Coins, New York City; Eugene Conran, New York City; A. R. Martin, Milwaukee, Wis.; May C. Martin, Chicago; A. W. Keith, Chicago; Ida Frank May, Englewood, Ill.; Ella A. Bingham, Birmington, Vt.; Otto Berner, Hamburg; James W. King, Philadelphia, Pa.; G. A. Sieber, Jacksonville, Ill.; Wm. G. Lawrence, San Bernardino, Cal.; W. A. Crawford, Cleveland, O.; J. T. McGuire, Seattle, Wash.; Lee McDuff, Detroit, Mich.; Moreman Smith, Toronto, Ont.; Herman Taner, Brockton, Mass.; Andrew Anderson, Meriden, Conn.; Chas. Peterson, Chicago; W. B. Allan, Chicago; J. Boyle Price, St. Louis, Mo.; W. M. Price, St. Louis, Mo.; J. B. De Matt, Cambridge, Mass.; W. S. Holton, Baltimore, Md.; J. Wm. Kimpel, Baltimore, Md.; T. C. Ware, Baltimore, Md.; S. J. Blight and wife, Baltimore, Md.; W. F. Hammond, Baltimore, Md.; S. C. Gray, San Francisco, Cal.; E. L. Cady, Penacook, N. H.; R. M. Beard, Waco, Tex.; A. R. Hall, Denver, Colo.; J. E. Hall, Pittsburgh, Pa.; A. E. Jones, New York City; Prof. A. Macfarlane, University of Texas; A. J. Clark, Grimes, Cal.; V. P. Hendrick, Chicago; P. F. Leach, Chicago; Daniel M. Sinclair, Chicago; H. W. Barton, Greenwich, Conn.; Geo. B. McClelland, Joliet, Ill.; Bess Thompson, Troy, O.; B. Strauss, Londonville, O.; C. J. Field, New York; Frank Baltrusch, New Ulm, Minn.; Hermann A. Schoede, Concordia, Mo.; Carl Hering, Philadelphia; R. E. McDowell, Yankton, S. D.; A. C. Eastwood, Clifton, Ky.; E. Braun, Frankfort, Me.; Ben M. Hammond, San Antonio, Tex.; Rudolph Hering, New York; C. M. Goddard, Boston; Frank Stillphlug, Kenaskew, Wis.; John Hoffmann, Chicago; A. S. Barbeau, Chicago; Hermann S. Hering, Baltimore; John C. Daniels, Keokuk, Ia.; H. W. Schroeder, Wichita, Kan.; J. B. Beckett, Woodbury, N. J.; Mrs. Frances Read Sullivan, Chicago; L. E. Gould, Owasso, Mich.; Thomas French, Jr., Cincinnati, O.; J. A. McCrossan, Rat Portage, Ont.; P. H. Carey, Chicago; P. S. Bemis, Jr., Chicago; W. F. Slater, Momence, Ill.; J. K. Sullivan, Denison, Tex.; Edw. T. Child, Philadelphia; H. W. Carver, Crowbey, La.; F. H. Talber, Atlanta, Ga.; W. H. Greene, Chicago; S. B. Fast, Jackson Park; Edwin L. Barker, Baltimore, Md.; C. H. Starr, Baltimore, Md.; F. S. Gassaway, Baltimore, Md.; H. C. Draver, Alliance, Neb.; Aug. Swansson, Detroit, Mich.; Jos. R. Little, Mobile, Ala.; E. W. Kittredge, Minneapolis, Minn.; E. L. Andrews, Lima, O.; Chas. Pollak, Germany; J. H. Parker, Boston, Mass.; Alfred E. Wiener, Schenectady, N. Y.; Ludwig Weber, Germany; Prof. Edwin J. Houston, Philadelphia, Pa.; Harriet L. Hering, Philadelphia; Marian W. Hering, Baltimore; C. B. Sears, Chicago; Gus Long, Chicago; Mrs. C. B. Sears, Chicago; H. Beigholtz, Ithaca, N. Y.; Mrs. H. Beigholtz, Ithaca, N. Y.; H. C. Allen, Paterson, N. J.; Louis Russell, Baltimore, Md.; L. J. Smith, Burlington, Wis.; W. C. Burns, Chicago; R. N. Walmsley, Edinburgh, Scotland; A. E. Kennelly, Orange, N. J.; C. H. Wollgren, Gothenburg, Sweden; H. H. Cooper, Boston, Mass.; Wm. W. Goode, Cincinnati, O.; Mrs. W. W. Goode, Cincinnati, O.; J. W. Farley, Equinunk, Pa.; A. L. Hawley, Seattle, Wash.; Gerald W. Hart, Hartford, Conn.; A. E. Carrier, Pittsburgh, Pa.; H. W. Beese, Boehnn, Wurtemburg; Mate McClevey, Boston; Rose McClevey, Boston; Jennie McClevey, Boston; John L. Sullivan, Boston; Prof. A. E. Dolbear, Tufts College, Mass.; Mr. and Mrs. Henry G. Issertel, New York City; C. H. McIntire, Newark, N. J.; R. Eickemeyer, Yonkers, N. Y.; M. J. Rosa, C. M., Niagara University, N. Y.; E. G. Bernard, Troy, N. Y.; A. W. Bonner, Indiana, Pa.; J. N. High, Arlington, Kan.; W. J. Shields, Philadelphia; H. W. Frund, Vincennes, Ind.; Geo. B. Hodge, New York City; G. L. Cole, Fort Atkinson, Wis.; Clarence S. Custer, Pottstown, Pa.; Chas. G. Lundquist, Jamestown, N. Y.; David Maloney, Jamestown, N. Y.; Austin M. Knight, U. S. Navy, Lynn, Mass.; W. S. Stratton, Green Bay, Wis.; F. B. Daggett, St. Joseph, Mo.; F. J. Rawlin, Aurora, Ill.; W. Nelson Smith, Chicago; W. R. Brixey, New York City; J. E. Ham, New York City; C. Olivetti, Ivrea, Italy; A. M. Schoen, Atlanta, Ga.; Paul H. Brangs, Hoboken; Dr. Louis Duncan, Baltimore, Md.; J. J. McKee, Bethlehem, Pa.; W. A. Wallace, Meriden, Conn.; Wm. Danforth, Jr., Red Wing, Minn.; Henry W. Frye, New York City; H. H. St. John, Yazoo City, Miss.; R. J. Covert, Ithaca, Mich.; C. Lotter, Bamberg, Germany; J. W. Morrison, Frankfort, Ind.; Henry L. McFarland, Chattanooga, Tenn.; Thos. D. Lockwood, Boston; Alex. G. Hawes, San Francisco, Cal.; F. M. Laughlin, Pittsburgh, Pa.; A. J. Wright, Cleveland, O.; T. F. Grace, New York; Jessup Moore, Philadelphia, Pa.; Frank Zone, Hillsboro, O.; J. F. Wilson, New York; Robert Ross, New York city; A. E. Jones, New York City; Theo. Butterworth, Chicago; Harry O. Bernard, Louisville, Ky.; Wm. E. Ross, Louisville, Ky.; Henry N. Howland, Baltimore, Md.; Edgar L. Larkin, Galesburg, Ill.; Romaine Mall, New York City; Geo. Low, San Francisco, Cal.; Max Osterberg, New York City; G. P. Roberts, Cleveland, O.; Andrew Spittal, Columbus, O.; H. E. Perkins, Kellerton, Ia.; A. Palaz, Geneva, Switzerland; T. W. Gosling, Cincinnati, O.; E. E. West, Atlanta, Ga.; A. P. Phillips, Atlanta, Ga.; H. A. Price, Bay City, Mich.; D. Roy Clayton, Athens, O.; A. L. McRae, Rolla, Mo.; C. H. Landwehs, Milwaukee, Wis.; C. A. Chapman, Akron, O.; Prof. F. H. Bigelow, Washington, D. C.; F. W. Jones, New York City; G. S. Leavenworth, Charlotte, N. C.; Thos. G. Orwig, Des Moines, Ia.; F. H. Green, Burlington, Ia.; A. F. Wineman, Chicago; Fubes Weber, Pittsburgh, Pa.; Samuel L. Whitestone, Boston, Mass.; Frank Vigars, Pullman, Ill.; F. B. Dudley, Sullivan, Ind.; F. Elfers, Kelley's Island, O.; Prof. Andrew Jamieson, Glasgow, Scotland; F. A. Hamilton, Chicago; Henry D. Wilkinson, London; Mrs. Geo. Wend, Albany, N. Y.; S. S. Howell, Chicago; Mrs. J. M. Finnegan, New Britain, Conn.; Mary Finnegan, New Britain, Conn.; Geo. J. Foster, Norwood, Mass.; Harry M. Hempstead, Stanton, Mich.; Henry Wichner, New Orleans, La.; A. B. Chamberlain, Newport, Vt.; E. B. Merrill, Toronto, Can.; S. D. Matt, Passaic, N. J.; May Peterson, Chicago; M. Johnson, Chicago; Lea Torbe, Milwaukee, Wis.; Will F. Hase, Milwaukee, Wis.; J. Walsh, St. Louis, Mo.; John Allen, Halifax; David S. Kindell, Harrisburg, Pa.; J. T. Barber, Philadelphia, Pa.; F. C. Russell, New York; Wharton Green, Jackson, Miss; Geo. B. Power, Jackson, Miss.; Chas. M. Underwood, Jr., So. Dennis, Mass.; Harriet Morgan, Chicago; John H. Hammar, Gottenburg, Sweden; Geo. Wm. Russell, Jr., Denver, Colo.; L. Stierinser, New York; R. Newell Reeves, Newark, N. J.; L. E. Fouts, West Point, Ind.; A. E. Worswick, Montgomery, Ala.; H. C. Beelman, Ashley, O.; Miss Susie C. Haas, Richmond, Va.; R. L. Simpson, Washington, D. C.; J. H. Adams, Thomas, Ala.; F. W. Fairfield, Nashville, Tenn.; W. A. Stevens, Freeport, Ill.; J. S. Harpster, Freeport, Ill.; W. C. Yeatman, Cincinnati, O.; W. H. Read, Duluth, Minn.; J. M. Downer, Cleveland, O.; J. F. Dusman, Baltimore, Md.; C. Schlesinger, La Salle, Ill.; Dr. W. H. Guess, Tiro, O.; E. R. Knowles, Middletown, Conn.; E. D. Warner, Jackson, Mich.; Harry M. Reynolds, Grand Rapids, Mich.; John J. Cooper, Denver, Colo.; C. D. Haskins, Boston; U. S. Guedry, Klotzville, La.; A. P. Stewart, Minneapolis, Minn.; Wm. Young, Philadelphia, Pa.; C. H. Becker, St. Louis, Mo.; T. S. McLoughlin, New Orleans, La.; Harry V. Haight, Sparta, Ont.; A. L. Daniels, North East, Pa.; W. H. Johnson, Washington, D. C.; D. Waldo White, Concord, N. H.; O. E. Stanton, Montreal, Can.; W. Wheaton, Minneapolis, Minn.; Wallace Franklin, Grand Rapids, Mich.; Emma West, Nashua, Mo.; Mrs. P. B. Thomson, Nashua, Mo.; H. E. Cooley, M. D., Belfast, N. Y.; John McCullagh, Galena, Kan.; J. E. Smith, New York City; J. Emory Clapp, Boston, Mass.; Joseph Young, Philadelphia, Pa.; Annie E. Young, Philadelphia, Pa.; F. E. Bausch, St. Louis, Mo..

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Sept. 16, 1893.

THE electrical trade is of course not failing to participate in the general revival of business, and the securities of the various electrical manufacturing and operating companies are evidencing by the strength of their quotations the bettered business that the companies are now doing. True, electric light, telephone and telegraph companies are not affected so much by depression in general trade, as their use is essential nowadays to the carrying on of any business whatsoever, but the big electrical manufacturing companies have admittedly been hard hit by the financial panic, and they are just about recovering from the distresses into which they have been plunged by the scarcity of funds. But they are getting out of the woods, and the higher range of quotations recorded this week reflects how much better off they are through the passing away of the crisis.

WESTINGHOUSE ELECTRIC, as representative of the companies whose managements have not been accused of speculative tendencies and which are run upon a purely business basis, bears out this argument. The gains in the quotations of its stocks are not great; on the other hand, they are steady and show none of that wild, erratic fluctuation that mere manipulation gives to a stock's value. The increased quotation represents an increased demand from genuine buyers, from real investors, who recognize that better times must soon be reflected in the earning capacity of a company managed from a business standpoint, and who know that a company whose affairs are run on the conservative, honest principles that the Westinghouse management always pursues must necessarily make sure returns at an early date upon the capital invested in its business.

GENERAL ELECTRIC, in the face of savage attacks from the bear crowd whenever opportunity warrants, continues remarkably strong. In their endeavors to force a lower quotation for this stock, the bears seize upon any pretext to attack its stock market value. The death of F. L. Ames, the Boston millionaire and capitalist, was in this way endeavored to be made use of. The late capitalist was a power in the General Electric Company. His interest in this corporation was one of his chief investments, and, when it is remembered that his fortune is estimated at $35,000,000, it is not surprising to read that he was one of the chief factors in the General Electric Company. Moreover, Mr. Ames had the reputation of being an extremely careful and able financier, and his wise counsels often prevailed to the General Electric Company's welfare. His self-assertiveness made his well balanced ideas sure to have weight in any policy that a company he was interested in was about to inaugurate, and his advice was continually sought by his colleagues on the various boards of directors of which he was a member. As a director of the General Electric Company, he was the originator of the plan to liquidate the floating debt by selling treasury securities and he was one of the heaviest underwriters to the new issue of securities whereby this plan is being carried out. Besides, he was ever free in extending liberal credits to the company, and his backing proved most invaluable during the recent financial stringency. His sudden demise is a great loss to the company. It is not likely that any of his vast holdings of General Electric bonds and stocks will be thrown upon the market in the division of his fortune among his heirs, and it is stated that as regards the underwriting of the bonds the estate will probably follow out the original contract. This is not the only trouble that the corporation has at present to contend with. Wall street repeats daily, with further and more elaborate details, the dissensions that exist among insiders. Denials are issued as fast as the stories are put into circulation of any split in the management, but it can be stated that everything is not as harmonious as the officials would have the public at large believe. The revelations regarding the "blue print steal," as made public in court in the trial at Pittsburgh, have set the different cliques more about their ears than ever. There are lots of other things affecting the management of the property that are making certain insiders daily more and more disgruntled, and the quarrel is reported to be assuming proportions that must soon result in an open and violent outbreak.

THE FORT WAYNE ELECTRIC PEOPLE, it is semi-officially stated, will break loose from the General Electric Company. Of course this statement is subject to modification when an official announcement regarding the relations of the two corporations is made; inside conditions just now are too sensitive and clashing to permit of any definite interpretation of the situation. Even now, it may be stated, its officers are reported busily engaged in opening up offices in the South and the Northwest, which are to be used as central distributing points for the output of the Fort Wayne company alone. Direct invasion of a territory almost exclusively in the General Electric's control is hereby threatened.

THE WESTERN UNION TELEGRAPH COMPANY'S directors met on Wednesday, and, pursuant to a recommendation offered by the Executive Committee, a regular quarterly dividend of 1¼ per cent. was declared. It is payable Oct. 16. The estimated statement of earnings for the quarter ended Sept. 30 is, as has been predicted in these letters, a poor one. As against an estimated net revenue for a similar period in 1892

of $2,200,000 and in 1891 of $2,000,000, there is an estimated net revenue of $1,800,000. This is $150,000 more than was allowed in the calculation made by The Electrical World in its last week's review of the electrical stock market, but how reliable these estimates are can be judged when it is stated that the net revenue estimated for the June 30 quarter was $1,800,000, while the actual surplus for the quarter, as now reported, shows that but $1,677,907 was earned. During the June quarter there were no unusual circumstances, excepting the closing of the pool rooms (and the loss of income from this source was said to have been taken into account in making up the estimate), to account for this difference between the estimated and actual net revenue. In July and August there were tremendous storms, with consequent great loss to the company through destruction to property and interruption to business. September's business must be tremendous to make up what has been lost. Unless September earnings show up remarkably well, why should the net revenue for the current quarter exceed the net revenue of the previous quarter, when it was but $1,677,907? If they don't, and there is no reason why they should, then The Electrical World's estimate will be found to be nearer the truth than the official estimate. Of course the probable reduction in the net revenue will not affect the dividend, as it only requires $1,185,000 to pay 1¼ per cent. on the $94,820,000 capital stock actually issued. There is an estimated surplus on Sept. 30 of $7,258,473. Last year it was $14,455,757, and the year before $12,097,948. Of the present surplus $5,180,000 is represented by 51,800 shares of the company's stock in treasury.

THE AMERICAN BELL TELEPHONE COMPANY has declared its regular quarterly dividend of $3 per share, payable Oct. 16 to stockholders of record Sept. 30. The capital stock of the company is now $20,000,000, and there is a comfortable surplus left after providing the $600,000 necessary to pay the 3 per cent. dividend.

THE CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY is seriously hampered in its service by the Brazilian revolt. President Scrymser states, however, that patrons are being served by other routes, and that no serious loss of revenue is threatened by the difficulty, which does not promise to be of long duration.

THE EDISON LIGHT AND POWER COMPANY, of San Francisco, has declared the regular monthly dividend at the rate of 8 per cent. per annum. It is payable Sept. 15. New York stockholders of record will be paid in this city at the company's fiscal agency.

ELECTRIC TRACTION rights have furnished one of the features of this week's stock market in Philadelphia. A week ago they were quoted at 3½; now they are 12 bid. The first installment of $5 a share is payable next week, and it is proposed to proceed at once with the improvement of the Tenth and Eleventh street line.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " com	15	15	17½
Edison Electric Ill., New York	100	97	98
" " " 1sts	...	95	96
Edison Electric Ill., Brooklyn	100	95	100
" " " Boston	100	120	125
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	..	2¼	5
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	5	5½
General Electric Company	100	47	47¼
" " deb. 5's	..	78½	79
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	22	23
" " pfd	50	42	43

TELEGRAPH AND CABLES.

American District Tel	100	54¾	55
American Tel. & Cable	100	80	82
Central & So. Am. Tel	100	..	111
Commercial Cables	100	110	150
Gold & Stock Tel	100	97	102
Franklin	100	35	40
Mexican Telegraph	...	180	200
Northwestern Telegraph	...	100	...
Pacific & Atlantic	...	50	60
Postal Tel. & Cable	...	40	60
Southern & Atlantic Tel	25	75	80
Western Union	100	82¾	83

TELEPHONE STOCKS.

American Bell	...	189	190
Erie Telephone	.	41½	42
New England Telephone	...	49⅞	50
N. Y. & N. J. Telephone	...	86	89
Metropolitan Tel. & Tele Co	...	200	....

AFFAIRS OF THE COMPANIES.

THE ATLANTA BRANCH OF THE GENERAL ELECTRIC COMPANY is to be abolished. This consisted of offices in the Equitable Building and a large factory on Marietta street for manufacturing and repair work.

THE THOMSON-HOUSTON ELECTRIC COMPANY, a local lighting company formerly called the East River Electric Light Company, has had proceedings instituted against it with a view to the appointment of a receiver.

THE BEVERLY (N. J.) AND EDGEWATER ELECTRIC LIGHT COMPANY has been placed in a receiver's hands. Mr. Daniels, manager of the Burlington Electric Company, was appointed receiver by Chancellor McGill. The liabilities are $37,000, of which the Fort Wayne Electric Company, which made the application, holds $7,000. The value of the assets was not disclosed.

ALEXANDER, BARNEY & CHAPIN.—An execution has been issued for $16,549 against Alexander, Barney & Chapin, No. 20 Cortlandt street, New York, in favor of Patrick Gray, on assigned claims of Luke A. Burke. The business was started several years ago by P. H. Alexander, of Hyde Park, Mass.; Gen. C. H. Barney and Charles B. Chapin, of Hartford, Conn. They incorporated it in November, 1890, with a capital stock of $100,000. Luke A. Burke, a builder, obtained control of the company in 1891, becoming vice-president, and Messrs. Alexander, Barney and Chapin retired from the concern. The annual report last January said the liabilities did not exceed $65,000, and the assets were worth $75,000.

THE ELECTRICAL DEVELOPMENT COMPANY.—An attachment for $3,000 has been obtained against the Electrical Development Company in favor of Thomas D. Bowen, on 30 notes dated March 1, 1893, payable six months after date to the order of Eaton & Lewis. It was granted on the ground of its being a foreign corporation. The office was formerly at No. 42 Broad street, but it was said there yesterday that the company had removed its office to Jersey City. The company was incorporated about three years ago with a capital stock of $150,000, and was interested in an electric light plant and street railroad at Schenectady, N. Y. Samuel Insull was formerly president, but has been succeded by J. H. Herrick.

THE ST. LOUIS ELECTRIC LIGHT CONSOLIDATION.—The reported absorption of the Municipal Electric Light and Power Company and the Missouri Electric Light and Power Company by the Edison Illumination Company is probably true. The stockholders and bondholders of the Missouri and Municipal companies will exchange their property for cash and Edison securities. The Municipal company has a debt of $1,500,000 six per cent. bonds, and a capital stock of $1,500,000. The Missouri company has issued $500,000 first mortgage six per cent. bonds and $600,000 second mortgage six per cent. bonds. The law requires them to have a capital stock at least equal to the sum of the bond issues.

THE BOARD OF DIRECTORS of the Edison Illuminating Company, of Brooklyn, have declarded the regular 1¼ per cent. dividend. The books will be closed on the 22d inst., and opened on Oct. 2. The eight months of this year as compared with the same period last year show the gross earnings to have been in 1892 $130,046.55, in 1893 $196,791.74; the net earnings to have been $50,382.86 as compared with $83,532.47 this year. The surplus has been increased from $33,696.13 to $66,865.80 in 1893. For August the gross earnings were $17,761, an increase of $3,548; net $4,702, increase $1,687; other sources $1,127, increase $627; net result $5,830, increase $2,314; less interest on bonds $2,100, leaving net for dividends $3,730, increase $2,315.

NEW INCORPORATIONS.

THE ELECTRIC LETTER BOX COMPANY, Meriden, Conn., capital stock $8,000, has been incorporated to manufacture and sell novelties of all kinds. The promoters are R. L. Baldwin, B. F. Barnes and John Fredermick.

THE PALL MALL ELECTRIC ASSOCIATION, New York City, maximum capital stock $20,000, has been formed to manufacture and sell electric curative and other goods. Ruth E. Scott, Georgiana Scott and J. H. Hawkins, all of New York City, are the promoters.

THE AUGUSTA ELECTRIC COMPANY, Jersey City, N. J., capital stock $25,000, has been formed to operate and maintain plants for producing electricity for light, heat and power. F. B. Poor, L. C. Harris, Hackensack, and A. L. Furnald, Brooklyn, N. Y., are the promoters.

THE AMERICAN RAILWAY ELECTRIC LIGHT COMPANY, New York City, capital stock $3,000, has been incorporated to manufacture and sell devices for lighting railway cars, etc. A. B. Cornell, Ithaca; H. R. Wibert and H. G. Payne, New York City, are interested.

THE BRONX GAS AND ELECTRIC COMPANY, Westchester, N. Y., capital stock $500,000, has ben formed for the purpose indicated by its title. C. H. Usher, 512 Halsey street; Jas. McGee, 454 Halsey street, Brooklyn, and E. W. Taylor, Unionville, L. I., N. Y., are the organizers.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Sept. 18, 1893.

RAPID TRANSIT.—It is now stated that Ryan & McDonald, of Baltimore, Md., will offer to build an underground road.

MR. JOHN M'GHIE, of the General Electric Company, New York, is in Chicago, where he will remain some two weeks. Mr. McGhie is well known among the fraternity as having charge of the newspaper work for the General Electric Company.

MR. J. M. LAMADRID, 136 Liberty street, New York, reports that his company, the Anglo-American Electrical Manufacturing Company, is receiving large orders for telephones and electrical supplies from Central and South America, and also from the West Indies.

WM. C. CALLMAN & CO., of 136 Liberty street, reports the sales of the Phoenix coiled filament lamp as constantly increasing. The written guarantee of 600 hours life, which is made on all lots of one barrel or over, is a pleasant feature to purchasers who have before had unpleasant experience with poorly made lamps. All candle powers from 10 to 200 are furnished promptly.

YOUNG MEN'S INSTITUTE.—On Tuesday evening, Oct. 3, special exercises will be held in the Hall of the Young Men's Institute, 222 and 224 Bowery, to formally open the educational work for the season of 1893 and 1894. This institute has for several years been doing very good work in offering to young men engaged during the day exceptionally good evening classes in subjects bearing directly on their daily work. The curriculum includes classes in steam engineering, practical electricity, mechanical, architectural and free-hand drawing and carriage drafting; also practical arithmetic, penmanship, bookkeeping, shorthand, typewriting, English grammar and composition, vocal music, etc. The school continues until May, when prizes, diplomas and certificates are awarded. The classes are open to all young men from 17 to 35 years of age.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Sept. 16, 1893.

GEO. P. LOW, of San Francisco, was a visitor to Boston this week.

MR. PARKER, manager for C. S. Knowles, has returned from his vacation.

GETHINS ELECTRIC COMPANY, Boston, Mass., has just received a large order from the War Department of the U. S. government.

THE ANSONIA ELECTRIC COMPANY, Ansonia, Conn., has resumed work under the management of the receivers. The business outlook is hopeful.

MR. PRENTISS CUMMINGS, who at present occupies the position of vice-president, is likely to succeed to the presidency of the West End Street Railway. Mr. Whitney will still continue to be a director.

THE BOSTON & MAINE RAILROAD has closed its contract for an extensive power and electrical equipment for the new terminal station in Boston. The plant represents an aggregate capacity of 1,000 h. p. in the engine room, with corresponding equipment throughout. There are four Westinghouse generators coupled direct to Westinghouse compound condensing engines of 200 h. p. each. Two of these generators supply some 4,000 incandescent lights for the interior service of the building, head house, etc.; the other two furnish power to the various motors operating drawbridges, turntables, elevators, coal handling machinery, etc. Besides these, there are two more compound engines, respectively of 200 h. p. and 100 h. p. each, driving alternating current machines for the distant lighting at Prison Point and East Somerville, together with the track lighting and signal towers. Each of these engines exhausts into an independent Bulkley condenser using salt water. A battery of 12 horizontal return tubular boilers supplies steam at 125 lbs. pressure. A striking feature of this plant will be the system of mechanical draught which takes the place of a chimney 200 ft. high, otherwise required. Instead of this a steel stack rising only 55 feet above the ground level delivers the flue gases at a height sufficient to clear the roof. Draught is furnished by two large Sturtevant fans, each driven by a small independent engine, and each capable of performing the whole service when required. The hot flue gases are drawn through Greene economizers, and the heat extracted returned to the feed water. It is claimed that not only will this arrangement secure an increased economy of fuel and place the control of the draught in the hands of an engineer to be manipulated at pleasure, but in this case it will greatly reduce the first cost below that of the equivalent chimney built upon the piling foundations necessary from the location. The engineer in charge for the company is Mr. George H. Barrus, and the contract in full was awarded to the Boston office of Westinghouse, Church, Kerr & Co.

WESTERN NOTES.

CLEVELAND, O., Sept. 16, 1893.

THE SHORT-RUSSELL-SCOFIELD consolidation was again before the Common Council Monday night, and has become a weekly feature at the meetings.

THE REBUILT OPERA HOUSE opened on Monday and the electric plant installed by the Ohio Construction Company has been the subject of much praise. The switchboard is so arranged as to be easy of manipulation, and, besides the ordinary arrangements for theatre illumination, several special features were introduced very successfully.

THE CIVIL ENGINEERS' CLUB, at its meeting on Sept. 12, listened to interesting papers read by Mr. T. D. West and Prof. Benjamin. The former, on the establishment of competitive manufacturing enterprises, laid stress upon the location of manufactories with reference to shipping and receiving facilities, and particularly upon the matter of the character of employes obtainable. In order to break in new men and develop the weak points in a system it was declared not advisable to rush matters the first year of a new enterprise. The discussion was participated in by Prof. Roberts, Mr. Walker, Mr. Gobeille, Mr. Herman and others. Prof. Benjamin's paper was on the strength of steel tubes of considerable diameter when lying on a solid foundation and with a load resting on a line on the opposite side of the tube.

News of the Week.

ELECTRIC LIGHT AND POWER.

NEWPORT, PA.—The Council is considering the electric light question.

KEWAUNEE, ILL.—The electric light company will increase the capacity of its plant.

GARRETTSVILLE, O.—The electric light plant for Garrettsville and Hiram will cost about $10,000.

PHELPS, N. Y.—H. E. Edson and M. J. Delling have applied for a franchise for an electric light plant.

LOS ANGELES, CAL.—The Los Angeles Iron and Steel Company will erect a rolling mill and put in electric lights.

NORRISTOWN, PA.—The Directors of the Poor of Montgomery County propose to light the almshouse with electricity.

WASHINGTON C. H., O.—The Washington Electric Light, Heat and Power Company has increased its capital stock from $10,000 to $30,000.

MARTIN'S FERRY, O.—An electric lighting company has made an offer to locate a plant here, and it is being considered by the City Council.

THEATRE LIGHTING.—An electric lighting plant has been installed in Miner's Theatre. A Payne engine and Edison dynamos are used, having a capacity of 1,200 lights.

ELKINS, W. VA.—The Council passed an ordinance authorizing the Valley Improvement Company to construct and maintain an electric light and power system in Elkins.

FARMINGTON, ILL.—Mr. David Nappin intends to increase the capacity of the electric plant. A 150-h. p. boiler and new dynamo and an engine with a capacity of 1,500 lights will be added.

WATSEKA, ILL.—The Watseka Electric Light Company has arranged to construct a new building for its plant, and put in its own engine. Heretofore the planing mill has supplied the power to run the dynamos.

DETROIT, MICH.—The site for the city electric light plant has cost the city $12,000 more than the estimate, and the building it is said will exceed the allowance by $15,000 more. The entire cost as estimated was $600,000.

ATHENS, GA.—The Athens "Banner" calls attention to the fact that next July the contract for street lighting with the present company will expire, and it urges that the city buy or build a plant, and issue bonds to pay for the same.

PHILADELPHIA, PA.—Wendell & Smith, representing the Drexel-Childs-Walsh syndicate, have applied for charters under which to operate their steam heating and electric lighting plant at Overbrook, where they propose to erect a large power house.

CAMDEN, ARK.—The plant of the Camden Electric Light and Power Company was sold at public auction at a receiver's sale. The General Electric Company, of Chicago, were the purchasers. Consideration, $30,000. The plant will be considerably improved.

LACONIA, N. H.—The Committee on Street Lighting are authorized to obtain estimates from any responsible electric company of the cost of an arc light plant suitable for the needs

of Laconia. Councilman Moore is at the head of the movement.

KALAMAZOO, MICH.—The Kalamazoo City Council, which recently voted to terminate its contract with the Kalamazoo Electric Company, for lighting the city streets, Tuesday night voted to advertise for bids for lighting the city for five years or more.

PORT DEPOSIT, MD.—Work on the Tome Institute is nearing completion, and in order to effectually light the building by electric light, Mr. Tome has bought a controlling interest in the old plant which was burned two years ago. This he will rebuild, put in a larger plant, and erect a more substantial building.

WARSAW, ILL.—At a meeting of the Warsaw City Council, an ordinance granting a franchise to H. C. Riner, of Keokuk, to erect poles and wire in the city for the transmission of electricity for illuminating, heating and power purposes was passed, with a proviso that work should be commenced within one year and finished within two years.

ROME, N. Y.—C. O. Mailloux, the New York electrical expert, has submitted a report in the matter of the proposed municipal electric lighting. He states that the present price paid for light is excessive, that a plant could be set up for about $50,000, and that the city water power could be used with good results. The special committee has adopted his report and recommended it to the Common Council.

ATTLEBORO, MASS.—The town's electric lighting committee is asking for figures from contractors for the new electric lighting station, to be 100 by 55 feet, of brick, and with a tower, and to be built as an addition to the pumping station of the water department, which it will match in style of architecture. Nothing has been done in the matter of the dynamos, engines, etc., which are to go into the building, but Secretary Webster, of the committee, states that it is expected that with the improvement in the money market, something will ere long be done. He further states that no agreement has been reached with the owners of the old plant.

THE ELECTRIC RAILWAY.

CAPE MAY, N. J.—The Cape May trolley line is to be extended and a double track laid along the beach.

SALINE, MICH.—The Council has passed an ordinance giving D. S. Nesmith a 30-years franchise to operate a line connecting that city with Ann Arbor, Clinton and Adrian.

CINCINNATI, O.—Ground will be broken before Oct. 1 for the Riverside Electric Railroad extension. The line will extend down Hillside avenue to the rolling mill and Lower River road.

MILLVILLE, N. J.—The City Council has passed an ordinance granting right of way for the trolley line of the Millville Rapid Transit Company, and allowing them to lay rails on the streets.

HARRISBURG, PA.—At a meeting of the stockholders of the East Harrisburg Passenger Railway Company it was decided to increase the capital stock of the company from $500,000 to $1,000,000.

LOS ANGELES, CAL.—The Board of Supervisors ordered that the franchise for the building of an electric railway between this city and Pasadena be again advertised for sale to the highest bidder.

PHILADELPHIA, PA.—Samuel Hart & Sons have been awarded the contract to build the new power house of the Philadelphia Traction Company, and ground will be broken next week for this work.

MOUNDSVILLE, W. Va.—Contracts will soon be let for the construction of the electric railway between Moundsville and Benwood. It is to be eight miles long. John W. Burchinal, of Moundsville, is interested.

KANSAS CITY, MO.—Extensive improvements will be made to the Northeast Electric Railway plant. Much of the rolling stock will be replaced or repaired and the track relaid. Frank J. Phillips is superintendent.

ROYERSFORD, PA.—The Royersford Town Council has unanimously granted right of way to the Royersford & Spring City Electric Railway Company, and they will build a line on Main street and Second avenue to the borough line, the road to be in operation within two years.

WILMINGTON, DEL.—The incorporators of the Wilmington, Chester & Philadelphia Electric Railway have organized, and James C. McComb was elected president. Work on the road will be commenced and completed within the year; $10,000 in stock has already been subscribed.

LANCASTER, PA.—The syndicate headed by ex-United States Senator John J. Patterson, which bought up all the electric railways in and leading out of this city, and which owns the franchise for the electric road between Philadelphia and this city, has bought the Columbia and Donegal electric line and the one leading from Columbia to Chickies Park.

CATONSVILLE, MD., is now in need of an electric line to connect it with Baltimore, and President Perin, of the City & Suburban Railway Company, states that he is most anxious to take steps to convert his Catonsville horse car line into an electric line; there is no doubt that ere long an arrangement will be made with the owners of the Frederick Turnpike, by which electricity may be used on the Catonsville branch of the City & Suburban Company's system.

WASHINGTON, D. C.—A bill has been introduced by Representative Meredith, in Congress, providing for the extension of the Falls Church & Potomac Railroad Company into the District. The bill provides that the road shall have the right of way through the grounds of Arlington, shall cross the Potomac by way of Analostan Island, and shall extend from the Naval Observatory grounds to Nineteenth street. A bridge is to be built across the Little River from the Virginia shore to Analostan Island, and the motive power in the District is to be approved by the committee.

YOUNGSTOWN, O.—The Park and Falls Improvement Company held a meeting recently at which it was decided that the work of building the street railway should be commenced at once. The organization was completed and the company will start work this fall, provided the charter is secured. They will build their own power house, and expect before spring to have the whole system in running order. The following directors were elected: S. C. Grier, Chas. Dahlinger, Barton Grubbs, Utiles Baird, Allegheny; Richard Brown, John I. Williams, George A. Baker, M. T. Evans and H. G. Hamilton, of Youngstown.

NEW HAVEN, CONN.—The Morris Cove, the Whitney Avenue and the State street surface railways have been bought by a syndicate organized last winter with $1,000,000 capital, and the three roads will be equipped with electricity. The city division will be running before December, and will be double tracked. The line will be extended to Lake Saltonstall next spring, and it will then include 42 miles of road. The new company has issued a mortgage to the American Loan Trust, of Boston, for $6,000,000. The new officers of the road are: David Corry, of New Haven, president; Charles A. Warren, vice-president; secretary, treasurer and general manager, George A. Dodge, of New Haven.

THE SIOUX CITY RAPID TRANSIT COMPANY, which hitherto has operated its cars by steam, and which was recently placed in the hands of a receiver, concluded to equip its lines with an electric system. This is an elevated road and extends to the suburbs about five miles distant. On Sept. 6 a number of prominent citizens of Sioux City was invited to ride over this line on a trial trip, and everything was found to work satisfactorily. Two Brill cars were fitted with McGuire trucks and a 30-h. p. No. 3 Westinghouse motor on each axle, a double trolley pole being used. The cars are 38 feet over all, vestibuled and weigh about 16 tons. The power is taken from the Sioux City electric light plant. This is one of the first elevated roads in the country to use electricity.

A NEW ENGLAND ELECTRIC RAILWAY SYNDICATE.—Senator Shaw, of Massachusetts, states that many of the recently built roads in various parts of Massachusetts have been sold and he believes that another spring will see one syndicate in control of all. It is reported that a syndicate is aiming to obtain control of all the electric roads in Maine, New Hampshire and Massachusetts, and connect the cities and towns of these States by a complete network. The start, it is reported, was made some weeks ago when a gang of surveyors opened up the country between Haverhill and Nashua, a distance of 40 miles. This road will extend across country to the latter city, and will pass through all the cities and towns of southern New Hampshire. Entering Haverhill it will connect with the Lowell, Lawrence & Haverhill road and thence extend to Amesbury and Newburyport. Another road will be built from the Amesbury line to Dover and Portsmouth, and along the New Hampshire and Maine beaches to Portland. This scheme will embrace the smaller roads now in operation and will help to effect the desired consolidation. The roads of southern Massachusetts and Rhode Island are controlled by various managements, but are fast coming under the control of the larger syndicates, such as the North Shore Traction Company, the West End Company and the Ames interests. For months the large concerns have been negotiating with the smaller companies, and the leading financiers of the State are in favor of and will work for the consolidation.

LEGAL NOTES.

THE UNION ELECTRIC COMPANY, of New York, has entered a suit against the Metropolitan Railroad Company, of Washington, D. C., claiming damages to the amount of $100,000. The declaration filed in the case recites that on the 14th of October, 1892, the Metropolitan Railroad Company applied to the Union Electric Company to deliver to the railroad company 1,000 storage batteries, or cells, of the "F 3" type, and 5,000 batteries, or cells, without jars of a special type, to be made by the electric company by certain agreed upon dates. It is alleged that 800 of the batteries were accepted by the railroad company of the "F 3" type, and $9,144.91 were paid, leaving $4,003.09 unpaid; that 210 of the other type were accepted, but the railroad refuses to accept the remainder, therefore depriving the electric company of $75,000 of profits and advantage, wherefore the said Union Electric Company claims damages to the amount of $100,000.

THE TELEPHONE PATENTS.—The U. S. Circuit Court of the northern district of Illinois has handed down a decision in favor of the plaintiffs in the cases of the American Bell Telephone Company vs. Sylvanus D. Cushman and vs. Wm. Hubbard. The Judge decided that "the particular devices respectively claimed by defendants have been declared to infringe. In the Hubbard case the Corwin telephone is the infringing device, and that was enjoined by Judge Acheson and afterward by Judge Lacombe. In the other case the Cushman telephone is used. That was also adjudged an infringing device by Judge Blodgett in American Bell Telephone Company vs. Cushman, 35 Fed. R., 488. I ought not, if I were so disposed—and I am not—to disregard these adjudications. In the one case the very device is adjudicated to infringe. In the other, not only so, but substantially as between these same parties; for I cannot but regard as a subterfuge the putting forward of Cushman's wife as the responsible infringer, with Cushman as a mere looker-on in the conduct of the business. A man cannot thus hide himself under his wife's petticoats. Cushman cannot thus avoid the consequences of the decree of the Court. That decree remains unimpeached and conclusive upon the rights of the parties." Referring to the dates which shall prevail in foreign patents the Court said: "The invention is not patented abroad before the actual sealing and issuance of the patent. It seems to me clear that the meaning of our own statute is to limit the term of the monopoly so that it shall not exist longer than a previously granted monopoly abroad. But it is not to be so limited unless the invention has been previously patented abroad. The term patented, as used in our statutes, does not mean the preliminary proceedings, but the actual issuance of the patent under the seal of the government speaking the exercise of sovereign will investing the patentee with the grant of a monopoly."

PERSONAL NOTES.

PROF. S. P. THOMPSON sailed on Saturday, Sept. 16, for Europe on the Lucania.

DR. A. C. CREHORE has been appointed Assistant Professor of Physics at Dartmouth College, Hanover, N. H.

MISS BERTHA LAMME, of Springfield, O., recently received a degree of electrical engineer at the Ohio State University. She is said to be the first woman in the world to receive this degree, and led her class all through the course. She has already accepted a position with the Westinghouse Electric Company, at Pittsburgh.

C. O. ROWE, superintendent of the Western Union Telegraph district comprising Western Pennsylvania, Eastern Ohio, Maryland and West Virginia, died at Titusville, Pa., on Sept. 12. Mr. Rowe was highly esteemed for his personal qualities and professional attainments, and had a fine war record in the army telegraph service.

MISCELLANEOUS NOTES.

THE COLORADO ELECTRIC LIGHT ASSOCIATION.—A meeting of the managers of electric light companies of Colorado was held at Idaho Springs in August, at which an organization was formed called "The Colorado Electric Light Association." A committee was appointed to draft a constitution and by-laws and the meeting adjourned to meet at Golden, on Sept. 18.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—The Council has voted that until further notice the monthly meetings will be held on the third Wednesday, instead of on the third Tuesday of each month, as heretofore. On Sept. 20, at 8 o'clock p. m., President Houston will deliver his inaugural address, the subject being "The Chicago International Congress." A paper will also be presented by Mr. D. McFarlan Moore, of the Engineering Department, General Electric Company, New York City, on "A New Method for the Control of Electric Energy."

PROF. GEORGE W. PLYMPTON, of the Brooklyn Subway Commission, has addressed a communication to the Commissioner of City Works in reference to the corrosion of water pipes and gas pipes through the action of the return electric current of the trolley roads. He says that since the corrosion is confined to certain limited areas where the wandering current leaves the pipe or cable to take to the ground, a method to prevent the destructive action would be to establish a metallic connection between the corroding surface and the negative poles at the lower station. He suggests that the City Works Commissioner require the trolley companies to immediately apply the remedy to water pipes and gas pipes wherever signs of the corrosion are to be found.

LUCIUS I. BLAKE, professor of electricity at the Kansas State University, has been engaged for the entire summer in experimenting with his invention for communicating between vessels at sea. This is the third summer that Professor Blake has been experimenting off the coast of New England. Prof. Blake and his assistants have been working on a scheme to connect by telephone the lightship at Pollock's Rip, in Vineyard Sound, with the mainland, so that incoming vessels may establish communication for reporting ships bound for this country from European points. Recently the official test was made and Prof. Blake's method accepted. The experiment will prove of great value to commerce, as incoming vessels will be reported at New York 24 hours earlier than is now possible.

THE DREXEL INSTITUTE OF ART, SCIENCE AND INDUSTRY, Philadelphia, Pa., has opened a course in electricity and electrical engineering under the direction of Prof. Arthur J. Rowland. The course covers the period of one year, and is intended to be thoroughly scientific and practical; it includes thorough instruction in the theory of electricity and a careful study of its practical applications, supplemented by experimental and laboratory work. A laboratory has been equipped with a complete outfit of modern electrical machinery and testing apparatus, including dynamos, both direct and alternating; motors, transformers, storage batteries, plating baths, arc and incandescent lights, and an excellent collection of measuring instruments. In the Institute building extensive mechanical and electrical plants are installed and the students have the privilege of constant reference to these. During the winter a course of evening lectures is to be given on electrical machinery and testing, accompanied by laboratory work; this course deals only with practical subjects, taking no more of theory than seems necessary. Mr. Rowland is a graduate of Johns Hopkins University and peculiarly well fitted to take charge of this work.

TELEGRAPH LINES IN THE SOUTH.—Col. J. E. Fenn, the chief Southern electrician of the Western Union company, reports that the injury done the company's wires by the recent cyclone was the greatest which had ever occurred south of the Ohio River. Notwithstanding the fact that the company usually has triple lines communicating with every point in the country, Charleston, S. C., was totally cut off from the outer world in every direction. To Kingstree, on the north, Branchville on the west, and Yemassee on the south, every wire was down. This practically meant that in order to establish any one of its lines 60 miles of wire had to be strung. The trouble came at the worst possible time. The Western Union company, together with every other business concern in the country, had cut down its working force in consequence of the generally prevailing business depression, and the force had only half its usual numbers. In some places the wires had been strung no less than four times, falling again within an hour or so after the workmen disappeared. The poles had not only been broken by the storm, but many of them had to be cut away to allow trains to pass, and then, to add to all the other complications, the washouts on the roads began and it was with great difficulty that the necessary materials could be got to the spots at which they were needed.

THE FORT WAYNE ELECTRIC COMPANY.—There have been many rumors in regard to the secession of the Fort Wayne Electric Company from the General Electric Company, but none of these thus far has been authoritatively confirmed. The New York "Commercial Advertiser," of Sept. 13, prints the following, which is of the same tenor as other rumors afloat:

"The fight htat is going on inside the General Electric Company between the Boston interests represented by the Thomson-Houston people and President Coffin on the one hand, and the New York interest, represented by Drexel, Morgan & Co., and Director H. McK. Twombly, is reported to have now reached the acute stage and to have precipitated the withdrawal from the combination of the Fort Wayne Electric Company, which is one of the largest subsidiary companies. Its withdrawal at this time abridges the manufacturing facilities of the central company, and will probably lead to considerable embarrassment. In Wall street the withdrawal is taken as expressing sympathy with the Boston people in the present fight with the New York people, and it is perhaps prompted further by the fact that during the financial difficulties of July and August the central company refused to honor a draft made on them by the Fort Wayne company for $15,000. The Fort Wayne company, whose stock is dealt in independently on the Boston Stock Exchange, is chiefly owned by R. T. McDonald, an Indiana millionaire, and the story among people informed on General Electric affairs is that Mr. McDonald proposes to establish an independent Western company, and to that end has succeeded in inducing a number of electricians and business men previously identified with the General Electric Company to promise cooperation as soon as a new company is formed. The Fort Wayne people own what is known as the Jenney patent, and it is believed that both in the direction of electric lighting and electric railroads that important competition will be esablished to the present business. The withdrawal of the Fort Wayne company is regarded as important because it is one of the largest of the allied companies in the West, and it is also taken as significant because the process of disintegration, which is the natural result of the internal conflicts of the General Electric Company looks as though it had fairly started and may be followed by the secession of other disgruntled companies."

Trade and Industrial Notes.

THE ELLIOT ELECTRIC COMPANY, Cleveland, O., has changed its name to the Elliott-Lincoln Electric Company, by which name it will hereafter be known. No other changes have been made, business relations, purposes and location remaining the same.

THE ELECTRICAL APPLIANCE COMPANY, Chicago, Ill., is placing upon the market a new iron box bell which has a number of improvements over the old form of bell, including an automatic set-screw on the adjustment, an armature spring that is attached to the soft iron armature without rivets and a frame made entirely of soft stamped iron. It is known as the "Acme" iron box bell.

THE RAILWAY EQUIPMENT COMPANY, Pullman Building, Chicago, Ill., has received from J. M. Akarman, of the Worcester (Mass.) Consolidated Street Railway Company, which is equipped entirely with the type "G" and other material manufactured by the Railway Equipment Company, a very complimentary letter stating that they have "the most perfectly equipped road in the country. Every part is first class."

THE CAMPBELL & ZELL COMPANY, Baltimore, Md., during the past 30 days has closed the following contracts for the Zell improved water tube safety boilers, aggregating over 5,000 h. p.; The Illinois State Penitentiary, Joliet, Ill., 1,212 h. p.; the Illinois State Reformatory, Pontiac, Ill., 600 h. p.; the new Stock Exchange, Chicago, 1,000 h. p.; the Bureau of Engraving and Printing, at Washington, 516 h. p.; the Baltimore City Passenger Railway Company, Baltimore, 2,000 h. p., and the Consolidated Gas Company, also of that city, 250 h. p.

THE CHICAGO-EDISON COMPANY has been installing in its Washington street plant, Chicago, Ill., some Reliance safety water columns. Chief Barrett, of the Department of Electricity at the World's Fair, has found the installation of the Reliance columns on the World's Fair grounds so satisfactory that he has decided to equip the boilers in the various electric and street railway plants in his charge with these columns as rapidly as possible. Among others of the companies that have recently adopted the Reliance columns may be mentioned the Citizens' Street Railway Company, Detroit, Mich.; the Citizens' Street Railway Company, Muncie, Ind., and the Cleveland Electric Railway Company, Cleveland, O.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

DESK ROOM in the commodious office of The Electrical World, in the new Monadnock Block, Chicago, may be obtained by applying in person or by letter to the office, 936 Monadnock Block.

THE ANSONIA ELECTRIC CO.
(Formerly The Electrical Supply Co.),
Corner Randolph St. and Michigan Ave.,
CHICAGO.

SPECIAL NOTICE.—An order of Court has been granted giving permission to continue the business, and orders intrusted to us will be given care and executed with the same promptness as heretofore. Prices will be made low, and customers will find it to their advantage to send us their orders. We particularly solicit orders for our specialties: Shield brand moisture proof wire, Habirshaw rubber covered wire, Stanley transformers, Helios alternating current arc lamps, Sunbeam incandescent lamps, Wirt indicators, Wirt dynamo brushes. We wish also to direct attention to our overhead electric railway material, which has been adopted by a number of the largest roads in the country. We have absolutely no complaints, and it is unquestionably the best line of railway material made.

THE ANSONIA ELECTRIC COMPANY
(J. B. WALLER, Assignee).
Corner Randolph St. and Michigan Ave., Chicago.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

UNITED STATES PATENTS ISSUED SEPT. 5, 1893.

(IN CHARGE OF W. A. ROSENBAUM, 177 TIMES BLDG., N. Y.)

11,364. (Reissue). ELESTRICALLY HEATED SOLDERING IRON; G. R. Meltzler, Cincinnati, O. Application filed July 3, 1893. An interiorly heated soldering tool having attachments to carry soldering fluid and solder connected to it, each one of the attachments having a snout to convey their respective charges to the point where they are used.

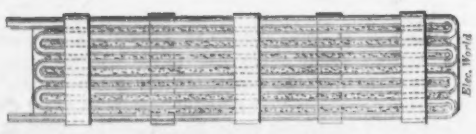
504,336. ELECTRIC BELT; W. C. Ekholm, Joliet, Ill. Application filed June 19, 1893. In an electric belt a cell composed of an oxidizable plate, such as zinc, having each end folded back over the sides of the cell, a cloth wrapping for covering the plate between its folded edges, a wrapping of asbestos cloth for covering the cloth, and a covering of chamois skin to cover the asbestos.

504,344. THERMAL CUT-OUT; W. M. Goodridge, Highland Park, Ill. Application filed Nov. 19, 1887. The combination with springs included in an electric circuit of a strip of conducting material in contact with the springs and held by the tension of these springs against a block or support inserted between the springs.

504,345. MULTIPLE SWITCHBOARD APPARATUS; W. M. Goodridge, Highland, Park, Ill. Application filed Jan. 12, 1889. A telephone line in combination with spring jack switches, one in each of two or more switchboards, an annunciator included in the line at one of the switchboards and an answering spring jack switch upon the same board with the annunciator included in the line between the annunciator and the ground.

504,367. CONDENSER TELEGRAPH SYSTEM; C. H. Rudd, Evanston, Ill. Application filed Feb. 8, 1893. The combination with a telegraph line and means for transmitting current of varying voltage over it, a condenser at a distant station included in the telegraph line, means adapted to discharge the condenser through a local circuit, each adapted to respond to a different current strength.

504,370. SECONDARY BATTERY; W. L. Silvey, Lima, O. Application filed July 8, 1892. This process consists in preparing a plate with ribs and perforations, filling the perforations with powdered oxide of lead in a dry state, then pickling the whole in a bath of a solution containing sulphuric acid until the oxide has become hardened, and afterward forming them by the passage of an electric current.



No. 504,455.—STORAGE BATTERY.

504,379. COMMUTATOR FOR DYNAMO-ELECTRIC MACHINES; E. P. Warner, Chicago, Ill. Application filed Nov. 1, 1892. A commutator composed of bars mounted on sleeves, one or more of which is free to move longitudinally along the axis of rotation.

504,397. ELECTRIC CONDUCTOR; J. W. Marsh, Pittsburgh, Pa. Application filed Aug. 8, 1892. A conductor having a covering of paper molded on it with grooves in its outer surface.

504,398. ELECTRIC CONDUCTOR; J. W. Marsh, Pittsburgh, Pa. Application filed Aug. 8, 1892. An insulated electric conductor having its insulating covering of paper supported by a cushion of fibrous material on the conductor.

504,401. ARMATURE FOR DYNAMO-ELECTRIC MACHINES; J. T. Morrow, Lynn, Mass. Application filed May 13, 1893. An armature core comprising layers of segmental laminae dovetailed to an internal supporting shell, in which the segments in consecutive layers break joints.

504,405. TROLLEY WIRE CLEANER; M. Shaaber, Reading, Pa. Application filed June 19, 1893. The combination with trolley wheel and frame in which the wheel is mounted of tangentially arranged scraper plates removably secured to the frame in front and rear of the trolley wheel and having their upper ends in sliding contact with the trolley wire and in fixed contact with the rim of the trolley wheel.

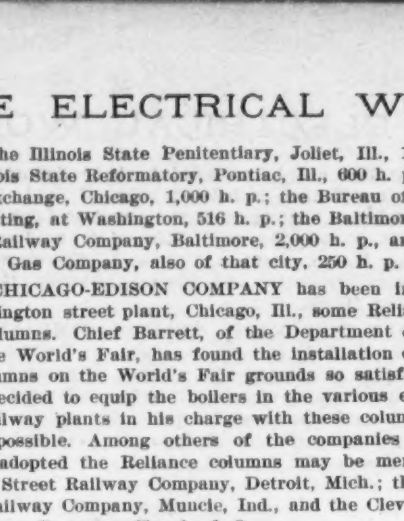
504,454. TELEPHONE TRANSMITTER; N. Parks, Deansville, N. Y. Application filed Dec. 6, 1892. This consists of a block of carbon having recesses formed in its opposite sides, in combination with electrodes loosely entering each recess and carrying the block.

504,455. STORAGE BATTERY; C. J. Reed, Orange, N. J. Application filed March 2, 1893. This consists of a series of thin, narrow strips of lead or equivalent conducting material having active coatings on their opposite faces, the opposite ends of the strips being bound together and the intermediate portions held together by a binding medium. (See illustration.

504,462. ELECTRIC LOCK; L. B. Tinkham, Quincy, Mass. Application filed May 9, 1892. An electric lock in which the bolt is located out of the path of the tumbler lever, said bolt having connected thereto a movable latch, an electromagnet and its armature, and suitable actuated mechanism intermediate between said armature and said latch, whereby the latch is moved when the magnet is energized..

504,464. SWITCHBOARD FOR TELEPHONING PURPOSES; U. H. Balsley, Philadelphia, Pa. Application filed June 8, 1889. In a switchboard for telephonic purposes the combination of two or more switch sections having connecting conductors of insulated wires secured together into a flat web or ribbon.

504,475. PENDENT INCANDESCENT ELECTRIC LIGHTS; W. A. Johnston and J. C. Davidson, Prince's Bay, N. Y. Application filed April 28, 1893. The combination of a support adapted to be fixed in position, a swinging suspending tube, a bearing piece within the support and connected with the suspending tube, a socket embracing the support, and carried by and adjustable on the tube, an adjusting sleeve on the suspending tube for yieldingly clamping the support between its socket and the bearing piece, a lamp carried by the suspending tube, and conducting wires passing through the support and tube.



No. 504,492.—ELECTRIC AUTOMATIC STEAM GOVERNOR.

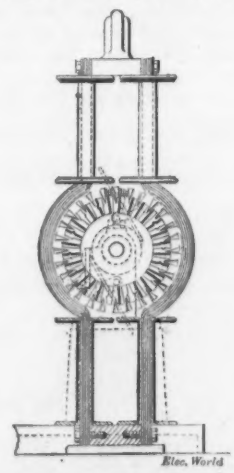
504,484. ELECTRIC LOCOMOTIVE; A. I. Ambler, Washington, D. C. Application filed Sept. 16, 1892. In combination with two supporting wheel axles of a tram or street car, and the single motor, the two shafts coupled to opposite ends of the armature shaft, and each carrying a worm, a worm gear wheel for each axle kept in mesh with the worm on the respective worm shaft and means for connecting the two worm wheels simultaneously with the respective supporting wheel axles, and disconnecting them therefrom at will.

504,488. CALL BOX; H. H. Cutler, Waltham, Mass. Application filed Jan. 13, 1892. In a call box having a winding handle, or the like, the combination of the main circuit with two branches thereto, within the box, one containing a starting magnet adapted also to give an alarm and embracing the signal wheel and finger, and the other containing a circuit breaker whereby the current will normally pass through the latter circuit, but when it is broken will be shunted to the former and thus give an alarm to show whether or not the line is busy.

504,492. ELECTRIC AUTOMATIC STEAM GOVERNOR; E. A. Edwards, Cincinnati, O. Application filed Dec. 2, 1891. The combination with a generator and motor therefor, of an electric automatic steam governor, the valve of which is normally completely opened, electrical devices connected with the generator for controlling the valve, and means for instantly completely closing the valve when released by the electrical devices. (See illustration.)

504,496. ELECTRIC WELDING APPARATUS; H. Lemp, Lynn, Mass. Application filed June 25, 1890. The combination of an electric metal working apparatus, of a movable work holder, means for operating the same by pressure of air, gas, water or other fluid, and regulating or adjusting devices for determining the force or pressure applied to said work holder when the metal becomes softened by the electric current.

504,497. METHOD OF AND APPARATUS FOR REGULATING ALTERNATING CURRENT DYNAMOS; H. Lemp, Lynn, Mass. Application filed Jan. 19, 1891. A method of regulating an alternating current dynamo, consisting in heating



No. 504,630.—METHOD OF OPERATING ELECTRIC MOTORS BY ALTERNATING CURRENTS.

an electric conductor placed in an alternating current circuit directly or indirectly by current delivered from said dynamo, and varying the excitation of the dynamo through the changes of resistance of said conductor due to the variations of the heating effect of the current.

504,523. DOUBLE POLE SWITCH; C. W. Gertside and R. E. Wood, Baltimore, Md. Application filed June 29, 1893. In a push button switch, the combination of the poles; a rocking lever pivoted between the poles and having contact pieces in engagement therewith; a spring pressed platform having position under the contact lever; a block interposed between the contact lever and the spring pressed platform, and having a projection abutting against the latter; and means for operating the rocking contact lever.

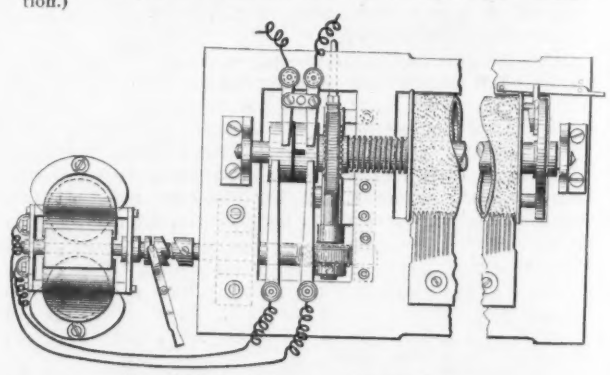
504,528. ELECTRIC SWITCH; A. B. Herrick, Schenectady, N. Y. Application filed July 21, 1892. A switch comprising an insulated base, a pair of terminal metal plates fastened thereto and formed with integral contact lugs projecting from them, the opposite sides of said lugs being finished in parallel planes in line with one another, a pair of flat elastic metal blades arranged to embrace the respective lugs between them flatwise to close the switch, and a block interposed between said blades, fastened to them, and by which they are moved.

504,542. ELECTRIC RAILWAY SIGNAL; F. E. Seagrave, Toledo, O. Application filed Jan. 26, 1892 In an electric railway signal, the two rails, a central conductor extending by sections the entire length of the rails, an engine provided with a revoluble wheel in contact with the conductor, an alarm mechanism within the cab, electrical communication with the conductor and either rail and the alarm mechanism in the engine adapted to be actuated when the circuit is closed by a like engine or circuit closer upon the conductor and either rail upon the tracks, a station, and connections with a key or circuit breaker in the station to establish communication with adjacent sections of the conductor and with the rail and the alarm mechanism.

504,549. CONDUIT ELECTRIC RAILWAY; B. Bidwell, Philadelphia, Pa. Application filed Sept. 4, 1884. In an electric railway the combination of a conduit having stationary conductors, an electrically propelled car having traveling connections terminating in laterally projecting ends, pivoted or hinged spring bearings on ends, and contacts on said spring bearings.

504,578. FLASH LIGHT APPARATUS FOR PHOTOGRAPHER'S USE; J. N. Harrison and H. J. Harrison, San Francisco, Cal. Application filed June 8, 1891. In a flash light apparatus the combination of an electric battery, conductors, electrodes having enlarged heads or ends, sleeves upon said electrodes, and means for operating said sleeves, a fusing wire connecting the ends of the electrodes, a flash pan or receptacle, and a circuit closer arranged for operation.

504,630. METHOD OF OPERATING ELECTRIC MOTORS BY ALTERNATING CURRENTS; A. Siemens, London, Eng. Application filed Oct. 21, 1890. The method of producing mechanical motion from electrical energy, which consists in generating an alternating current, transmitting it to a local point of consumption, and there producing in a motive device a succession of alternating polarities in the respective elements of the said device, so as to maintain their relation the same although their absolute polarities change. (See illustration.)



No. 504,671.—MUSICAL INSTRUMENT.

504,632. ELECTRIC ARC LIGHTING SYSTEM; T. Spencer, Philadelphia, Pa. Application filed Feb. 18, 1893. The combination with an electric arc lamp of a transformer having its secondary winding made in two sections, and a switch whereby said lamp may be included in circuit either with one or with both of said sections.

504,636. TELEPHONE APPARATUS; A. Stromberg and A Carlson, Chicago, Ill. Application filed April 3, 1893. In a telephone, the combination with a magneto generator of extensions from the poles thereof, the ends of said extensions being placed in proximity, a diaphragm opposite the ends of said extensions, and coils mounted upon the extensions, said coils being connected together in series; whereby the permanent magnetism of the magneto generator is utilized in producing voice currents and the voltage of said currents is the result of the added effect of the two coils.

504,638. WIRE SPLICER; J. D. Thomas, Scranton, Pa. Application filed April 21, 1893. A wire splicer, formed of a tube furnished with apertures for receiving dogs, and a series of dogs consisting of serrated wedges.

504,671. MUSICAL INSTRUMENT; C. Doriot, Philadelphia, Pa. Application filed April 17, 1893. A musical instrument provided with a pin-cylinder mounted on a shaft, a comb or combs for said pin-cylinder, a worm-gear actuating mechanism for controlling said shaft, a toothed speed controlling wheel mounted on said shaft and detachably engaging said worm-gear, an electric motor included in circuit and adapted to be connected with said mechanism, and means for stopping and starting said shaft. (See illustration.)

504,676. CONDUIT FOR ELECTRIC RAILWAYS; S. H. Flagg, Providence, R. I. Application filed Aug. 24, 1892. In a conduit for electric railways having a slot for the contact bar to pass through, and a shoulder or shelf at one side a cast glass tube, having a longitudinal slot on its inner side, and arranged on one side of said contact bar slot, said cast glass tube being imbedded in cement.

504,681. ELECTRIC CAR LIGHTING SYSTEM; I. N. Lewis, Fort Wadsworth, N. Y. Application filed Sept. 17, 1892. In a system for producing a continuous working current of electricity from an intermittent source of motion, the combination of a dynamo, having its field circuit connected in series with its armature circuit, a storage battery, a charging circuit, a discharging circuit, and a centrifugally controlled cut-out switch interposed in the charging circuit, connected with the variable speed source from which the dynamo is driven.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1836—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.